RICOH

R3150N Series

AEC-Q100 Grade 2 Compliant

36V Input Voltage Detector for Automotive Applications

NO.EC-230-150520

OUTLINE

The R3150N is a CMOS-based voltage detector IC that provides high-voltage resistance, high voltage accuracy and low supply current. This device is suitable for battery voltage supervisor. The R3150NxxxA/ B provide V_{DD} pin detection and the R3150NxxxE/ F provide SENSE pin detection. Detector threshold and Release voltage can be specified separately. Both the detector threshold accuracy and the release voltage accuracy are ±1.5% (25ºC) (Detector Threshold Hysteresis is 5% to 20%).
The detect output delay time and the release output delay time (Power-on Reset Time) are adjustable by using external capacitors. The output types are Nch open drain "L" output and Nch open drain "H" output.
The R3150N is available in SOT-23-6 package that is possible to achieve high-density mounting on boards.

FEATURES

- Operating Voltage Range (Maximum Rating) ·················R3150NxxxA/ B: 1.4V to 36.0V (50.0V)
  R3150NxxxE/ F: 3.6V to 6.0V (7.0V)
- Operating Temperature Range ·····································-40ºC to 105ºC
- Supply Current·· R3150NxxxA/ B: Typ. 3.8μA
  R3150NxxxE/ F: Typ. 3.5μA
- Detector Threshold Range··5.0V to 10.0V (0.1V steps)
- Detector Threshold Accuracy ·······································±1.5% (+25ºC)
  ±2.0% (-40ºC to 105ºC)
- Release Voltage Range*[1] ···5.3V to 11.0V (0.1V steps)
- Release Voltage Accuracy··±1.5% (+25ºC)
  ±2.0% (-40ºC to 105ºC)
- Detect Output Delay Time Accuracy ·······························-35% to 40% (-40ºC to 105ºC)
- Release Output Delay Time Accuracy ·····························-35% to 40% (-40ºC to 105ºC)
- Output Type ··Nch Open Drain
- Package···SOT-23-6

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

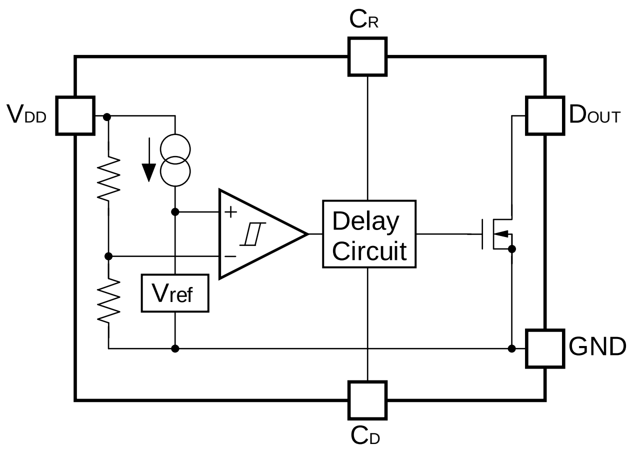
*[1] The release voltage can be adjusted by having the hysteresis set to 5% to 20% of the detector threshold.

APPLICATIONS

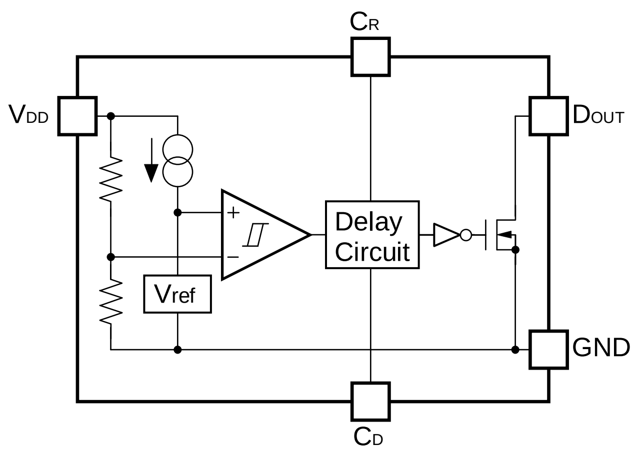
- Voltage monitoring for car accessories including car audios, car navigation systems, ETC systems.

BLOCK DIAGRAMS

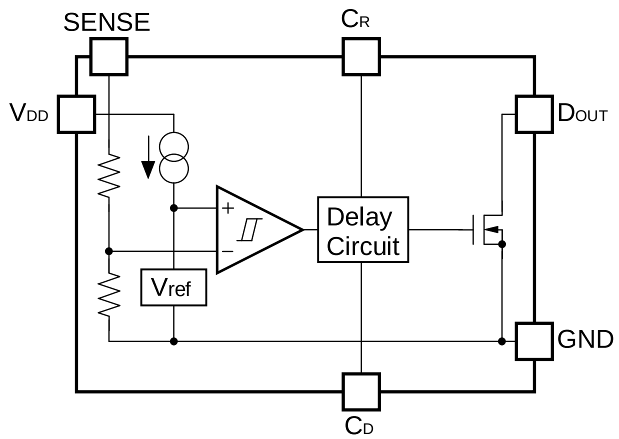
R3150NxxxA



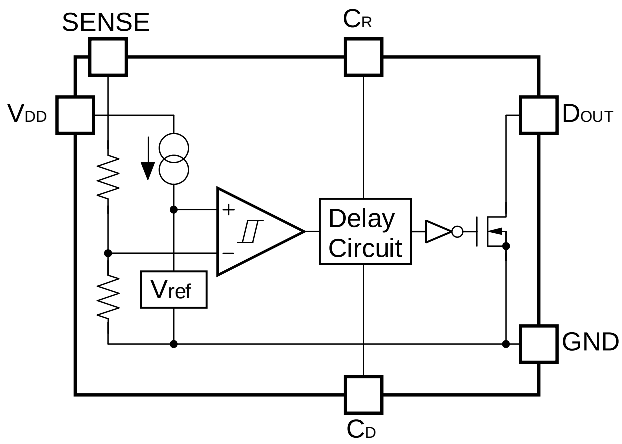
R3150NxxxB



R3150NxxxE



R3150NxxxF



SELECTION GUIDE

VD Detector Threshold and Release Voltage for the ICs are user-selectable options.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R3150Nxxx∗-TR-#E	SOT-23-6	3,000 pcs	Yes	Yes

xxx: Specify a combination of Set Detector Threshold ($-V_{SET}$) and Set Release Voltage ($+V_{SET}$) by using serial numbers starting from 001.
$-V_{SET}$ can be designated between 5.0V and 10.0V in 0.1V steps.
$+V_{SET}$ can be designated between 5.3V and 11.0V in 0.1V steps.

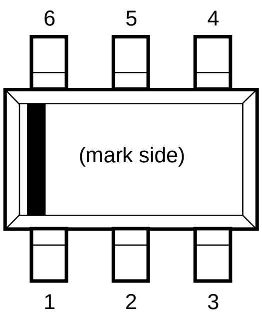
∗: Select an output type from below.
A: V_{DD} Voltage Detection Type "L" Output
B: V_{DD} Voltage Detection Type "H" Output
E: SENSE Voltage Detection Type "L" Output
F: SENSE Voltage Detection Type "H" Output

#: Specify Automotive Class Code

	Operating Temperature Range	Guaranteed Specs Temperature Range	Screening
J	−40°C to 105°C	−40°C to 105°C	High and low temperature

PIN DESCRIPTIONS

• SOT-23-6



Pin No.	Symbol	Description
1	C_D	Release Output Delay Time (tdelay) Setting Pin
2	C_R	Detect Output Delay Time (treset) Setting Pin
3	NC	No Connection (R3150NxxxA/ B)
	SENSE	VD Voltage SENSE Pin (R3150NxxxE/ F)
4	V_{DD}	Input Pin
5	GND	Ground Pin
6	D_{OUT}	V_D Output Pin (Nch Open Drain)

ABSOLUTE MAXIMUM RATINGS

Symbol	Item		Rating	Unit
V_{DD}	Supply Voltage (R3150NxxxA/B)		–0.3 to 50.0	V
	Supply Voltage (R3150NxxxE/F)		−0.3 to 7.0	V
V_{SENSE}	SENSE Pin Voltage (R3150NxxxE/F)		−0.3 to 50.0	V
V_{DOUT}	D_{OUT} Pin Output Voltage		−0.3 to 7.0	V
V_{CD}	C_D Pin Output Voltage		−0.3 to 7.0	V
V_{CR}	C_R Pin Output Voltage		−0.3 to 7.0	V
I_{OUT}	D_{OUT} Pin Output Curren		20	mA
P_D	Power Dissipation (SOT-23-6)*1	Standard Land Pattern	525	mW
Tj	Junction Temperature		−40 to 150	°C
Tstg	Storage Temperature Range		−55 to 150	°C

*1 Please refer to *PACKAGE INFORMATION* for detailed information.

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

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Rating	Unit
V_{DD}	Operating Voltage (R3150NxxxA/B)	1.4 to 36.0	V
	Operating Voltage (R3150NxxxE/F)	3.6 to 6.0	V
V_{SENSE}	SENSE Input Voltage (R3150NxxxE/F)	0 to 36	V
Ta	Operating Temperature Range	−40 to 105	°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 when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

ELECTRICAL CHARACTERISTICS

C_D=1000pF, C_R=1000pF, Pull-up resistance=100kΩ, Pull-up voltage=5V, unless otherwise noted.

R3150NxxxA/ B (-40°C ≤ Ta ≤105°C)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{DDL}	Minimum Operating Voltage[*1]					1.4	V
I_{SS}	Supply Current	V_{DD}= $-V_{SET}$ -0.1V			3.8	6.1	μA
		V_{DD}= $+V_{SET}$ +1.0V			3.8	6.4	
$-V_{DET}$	Detector Threshold	Ta=25°C		x0.985		x1.015	V
		-40°C≤Ta≤105°C		x0.980		x1.020	
$+V_{DET}$	Release Voltage	Ta=25°C		x0.985		x1.015	V
		-40°C≤Ta≤105°C		x0.980		x1.020	
treset	Detect Output Delay Time[*2]	C_R=1000pF, -40°C≤Ta≤105°C		6.5	10	14.0	ms
tdelay	Release Output Delay Time[*3]	C_D=1000pF, -40°C≤Ta≤105°C		6.5	10	14.0	ms
I_{OUT}	Output Current (Nch Driver Output Pin)	R3150NxxxA	V_{DD}=4.5V, V_{DS}=0.05V	0.5		2.0	mA
		R3150NxxxB	V_{DD}=13.0V, V_{DS}=0.05V				
R_{CD}	C_D Pin Discharge Tr. On Resistance	V_{DD}=13V, V_{CD}=0.5V		0.50		2.60	kΩ
R_{CR}	C_R Pin Discharge Tr. On Resistance	V_{DD}=4.5V, V_{CR}=0.5V		0.50		2.60	kΩ

[*1] The minimum operating voltage is the voltage required for the stable operation of the devices.
[*2] A time that V_{DOUT} requires to reach 2.5 V when changed V_{DD} from "$-V_{SET}$ +1.0 V" to "$-V_{SET}$ −1.0 V".
[*3] A time that V_{DOUT} requires to reach 2.5 V when changed V_{DD} from "$+V_{SET}$ −1.0 V" to "$+V_{SET}$ +1.0 V".

C_D=1000pF, C_R=1000pF, Pull-up resistance=100kΩ, Pull-up voltage=5V, unless otherwise noted.

R3150NxxxE/ F (-40°C ≤ Ta ≤105°C)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{DDL}	Minimum Operating Voltage*1					3.6	V
I_{SS}	Supply Current*2	V_{DD}=5.0V, V_{SENSE}= -V_{SET} -0.1V			3.5	5.5	μA
		V_{DD}=5.0V, V_{SENSE}= +V_{SET} +1.0V			3.5	5.6	
R_{SENSE}	SENSE Resistance			4.5		51.5	MΩ
-V_{DET}	Detector Threshold	Ta=25°C		x0.985		x1.015	V
		-40°C≤Ta≤105°C		x0.980		x1.020	
+V_{DET}	Release Voltage	Ta=25°C		x0.985		x1.015	V
		-40°C≤Ta≤105°C		x0.980		x1.020	
treset	Detect Output Delay Time*3	C_R=1000pF, -40°C≤Ta≤105°C		6.5	10	14.0	ms
tdelay	Release Output Delay Time*4	C_D=1000pF, -40°C≤Ta≤105°C		6.5	10	14.0	ms
I_{OUT}	Output Current (Nch Driver Output Pin)	R3150NxxxE	V_{DD}=5.0V, V_{DS}=0.05V, V_{SENSE}= -V_{SET} –0.1V	0.5		2.0	mA
		R3150NxxxF	V_{DD}=5.0V, V_{DS}=0.05V, V_{SENSE}= +V_{SET} +1.0V				
R_{CD}	C_D Pin Discharge Tr. On Resistance	V_{DD}=4.5V, V_{SENSE}=13V, V_{CD}=0.5V		0.50		2.60	kΩ
R_{CR}	C_R Pin Discharge Tr. On Resistance	V_{DD}=4.5V, V_{SENSE}=4.5V, V_{CR}=0.5V		0.50		2.60	kΩ

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

Product-specific Electrical Characteristics

R3150NxxxA

Product Name	$-V_{DET}$ [V] (Ta = 25°C)			$-V_{DET}$ [V] (−40°C≤Ta≤105°C)			$+V_{DET}$ [V] (Ta = 25°C)			$+V_{DET}$ [V] (−40°C≤Ta≤105°C)		
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.
R3150N001A	6.304	6.400	6.496	6.272	6.400	6.528	7.191	7.300	7.409	7.154	7.300	7.446
R3150N002A	8.373	8.500	8.627	8.330	8.500	8.670	8.865	9.000	9.135	8.820	9.000	9.180
R3150N003A	8.865	9.000	9.135	8.820	9.000	9.180	9.358	9.500	9.642	9.310	9.500	9.690
R3150N004A	5.812	5.900	5.988	5.782	5.900	6.018	6.698	6.800	6.902	6.664	6.800	6.936
R3150N005A	6.403	6.500	6.597	6.370	6.500	6.630	6.994	7.100	7.206	6.958	7.100	7.242
R3150N006A	6.206	6.300	6.394	6.174	6.300	6.426	6.797	6.900	7.003	6.762	6.900	7.038
R3150N007A	5.713	5.800	5.887	5.684	5.800	5.916	6.206	6.300	6.394	6.174	6.300	6.426
R3150N018A	5.910	6.000	6.090	5.880	6.000	6.120	7.092	7.200	7.308	7.056	7.200	7.344

R3150NxxxB

Product Name	$-V_{DET}$ [V] (Ta = 25°C)			$-V_{DET}$ [V] (−40°C≤Ta≤105°C)			$+V_{DET}$ [V] (Ta = 25°C)			$+V_{DET}$ [V] (−40°C≤Ta≤105°C)		
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.
R3150N001B	6.304	6.400	6.496	6.272	6.400	6.528	7.191	7.300	7.409	7.154	7.300	7.446
R3150N002B	8.373	8.500	8.627	8.330	8.500	8.670	8.865	9.000	9.135	8.820	9.000	9.180
R3150N003B	8.865	9.000	9.135	8.820	9.000	9.180	9.358	9.500	9.642	9.310	9.500	9.690
R3150N004B	5.812	5.900	5.988	5.782	5.900	6.018	6.698	6.800	6.902	6.664	6.800	6.936
R3150N005B	6.403	6.500	6.597	6.370	6.500	6.630	6.994	7.100	7.206	6.958	7.100	7.242
R3150N006B	6.206	6.300	6.394	6.174	6.300	6.426	6.797	6.900	7.003	6.762	6.900	7.038
R3150N007B	5.713	5.800	5.887	5.684	5.800	5.916	6.206	6.300	6.394	6.174	6.300	6.426
R3150N008B	7.388	7.500	7.612	7.350	7.500	7.650	8.865	9.000	9.135	8.820	9.000	9.180
R3150N011B	7.683	7.800	7.917	7.644	7.800	7.956	8.865	9.000	9.135	8.820	9.000	9.180
R3150N012B	7.191	7.300	7.409	7.154	7.300	7.446	8.570	8.700	8.830	8.526	8.700	8.874
R3150N014B	7.979	8.100	8.221	7.938	8.100	8.262	8.373	8.500	8.627	8.330	8.500	8.670
R3150N015B	5.910	6.000	6.090	5.880	6.000	6.120	6.403	6.500	6.597	6.370	6.500	6.630
R3150N016B	5.418	5.500	5.582	5.390	5.500	5.610	5.910	6.000	6.090	5.880	6.000	6.120
R3150N017B	5.221	5.300	5.379	5.194	5.300	5.406	6.206	6.300	6.394	6.174	6.300	6.426

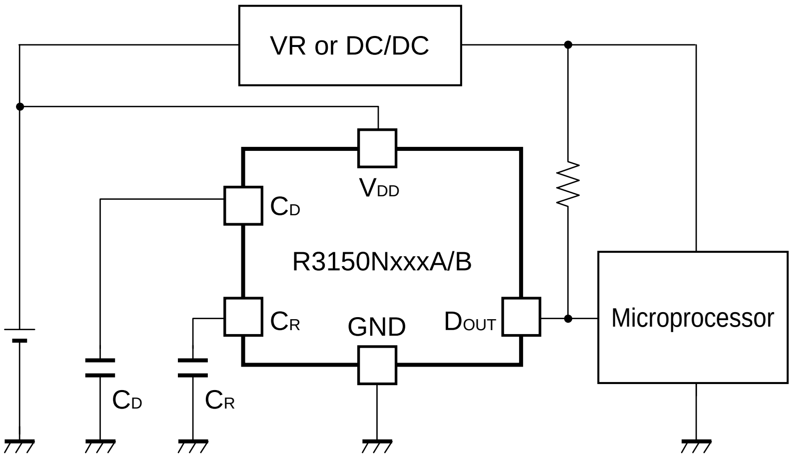
R3150NxxxE

Product Name	-V_{DET} [V] (Ta = 25°C)			-V_{DET} [V] (–40°C≤Ta≤105°C)			+V_{DET} [V] (Ta = 25°C)			+V_{DET} [V] (–40°C≤Ta≤105°C)		
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.
R3150N001E	6.304	6.400	6.496	6.272	6.400	6.528	7.191	7.300	7.409	7.154	7.300	7.446
R3150N002E	8.373	8.500	8.627	8.330	8.500	8.670	8.865	9.000	9.135	8.820	9.000	9.180
R3150N003E	8.865	9.000	9.135	8.820	9.000	9.180	9.358	9.500	9.642	9.310	9.500	9.690
R3150N004E	5.812	5.900	5.988	5.782	5.900	6.018	6.698	6.800	6.902	6.664	6.800	6.936
R3150N005E	6.403	6.500	6.597	6.370	6.500	6.630	6.994	7.100	7.206	6.958	7.100	7.242
R3150N006E	6.206	6.300	6.394	6.174	6.300	6.426	6.797	6.900	7.003	6.762	6.900	7.038
R3150N007E	5.713	5.800	5.887	5.684	5.800	5.916	6.206	6.300	6.394	6.174	6.300	6.426
R3150N013E	6.895	7.000	7.105	6.860	7.000	7.140	7.388	7.500	7.612	7.350	7.500	7.650

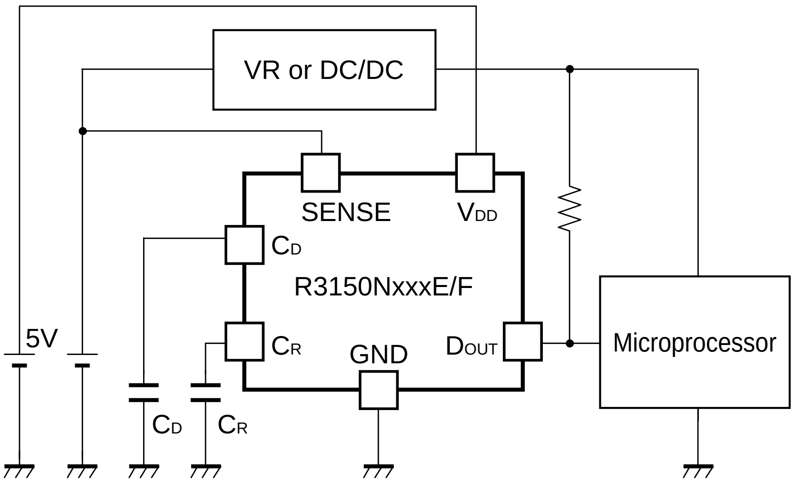
R3150NxxxF

Product Name	-V_{DET} [V] (Ta = 25°C)			-V_{DET} [V] (–40°C≤Ta≤105°C)			+V_{DET} [V] (Ta = 25°C)			+V_{DET} [V] (–40°C≤Ta≤105°C)		
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.
R3150N001F	6.304	6.400	6.496	6.272	6.400	6.528	7.191	7.300	7.409	7.154	7.300	7.446
R3150N002F	8.373	8.500	8.627	8.330	8.500	8.670	8.865	9.000	9.135	8.820	9.000	9.180
R3150N003F	8.865	9.000	9.135	8.820	9.000	9.180	9.358	9.500	9.642	9.310	9.500	9.690
R3150N004F	5.812	5.900	5.988	5.782	5.900	6.018	6.698	6.800	6.902	6.664	6.800	6.936
R3150N005F	6.403	6.500	6.597	6.370	6.500	6.630	6.994	7.100	7.206	6.958	7.100	7.242
R3150N006F	6.206	6.300	6.394	6.174	6.300	6.426	6.797	6.900	7.003	6.762	6.900	7.038
R3150N007F	5.713	5.800	5.887	5.684	5.800	5.916	6.206	6.300	6.394	6.174	6.300	6.426
R3150N008F	7.388	7.500	7.612	7.350	7.500	7.650	8.865	9.000	9.135	8.820	9.000	9.180
R3150N011F	7.683	7.800	7.917	7.644	7.800	7.956	8.865	9.000	9.135	8.820	9.000	9.180
R3150N012F	7.191	7.300	7.409	7.154	7.300	7.446	8.570	8.700	8.830	8.526	8.700	8.874
R3150N015F	5.910	6.000	6.090	5.880	6.000	6.120	6.403	6.500	6.597	6.370	6.500	6.630
R3150N016F	5.418	5.500	5.582	5.390	5.500	5.610	5.910	6.000	6.090	5.880	6.000	6.120
R3150N017F	5.221	5.300	5.379	5.194	5.300	5.406	6.206	6.300	6.394	6.174	6.300	6.426

TYPICAL APPLICATION



R3150NxxxA/ B Typical Application



R3150NxxxE/ F Typical Application

TECHNICAL NOTES

When connecting resistors to the device's input pin

When connecting a resistor (R1) to an input of this device, the input voltage decreases by [Device's Consumption Current] x [Resistance Value] only. And, the cross conduction current*[1], which occurs when changing from the detecting state to the release state, is decreased the input voltage by [Cross Conduction Current] x [Resistance Value] only. And then, this device will enter the re-detecting state if the input voltage reduction is larger than the difference between the detector voltage and the released voltage.
When the input resistance value is large and the VDD is gone up at mildly in the vicinity of the released voltage, repeating the above operation may result in the occurrence of output.

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

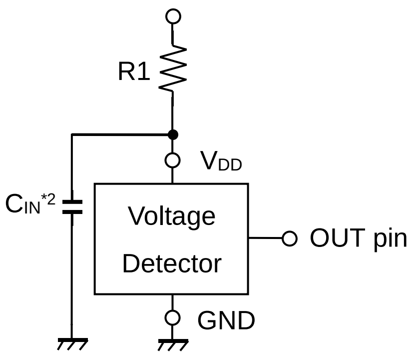


Figure A

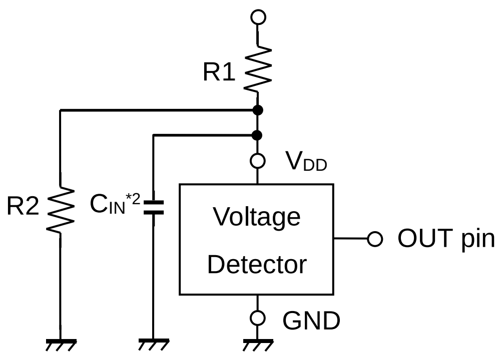


Figure B

*[1] In the CMOS output type, a charging current for OUT pin is included.
*[2] Note the bias dependence of capacitors.

Prohibited Area of Supply Voltage Fluctuations (V_{DD} Voltage Detection Type)

As for the steep change of the supply voltages in the prohibited area as shown in Figure C, the detector may cause a false detection if the supply voltage is over the detector threshold, as shown in Figure D. In addition, the detector may take an incorrect detect output delay time if the supply voltage is less than $-V_{DET}$, as shown in Figure E.

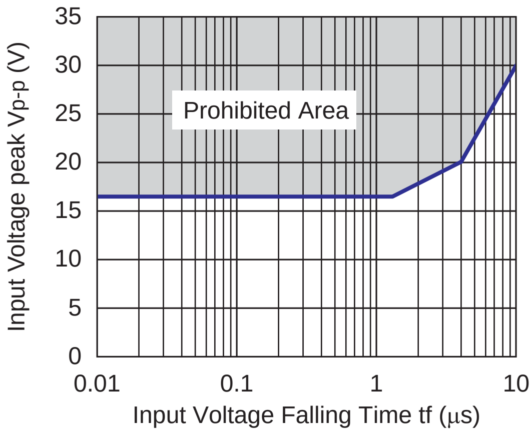


Figure C. Prohibited Area

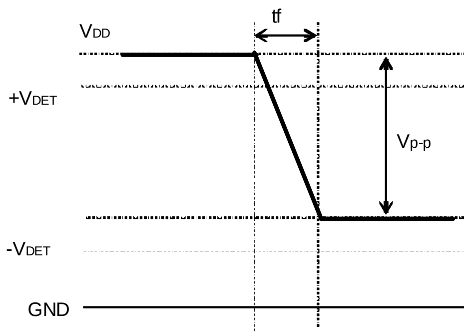


Figure D

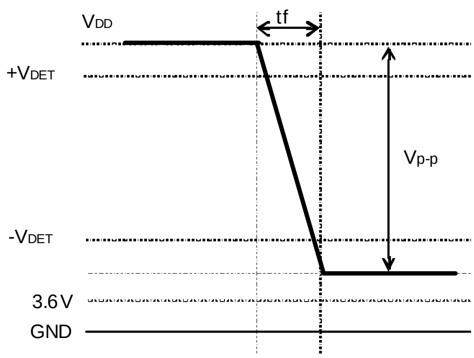
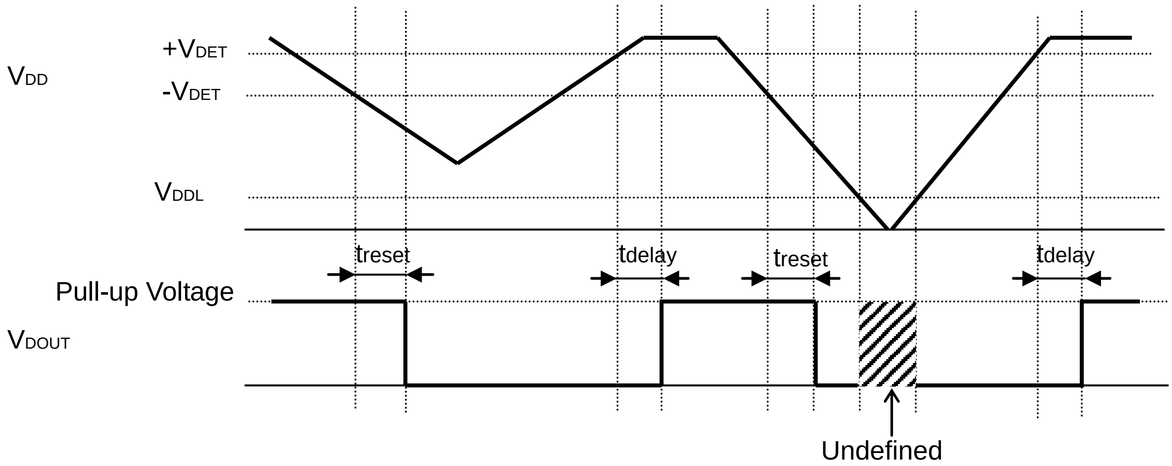


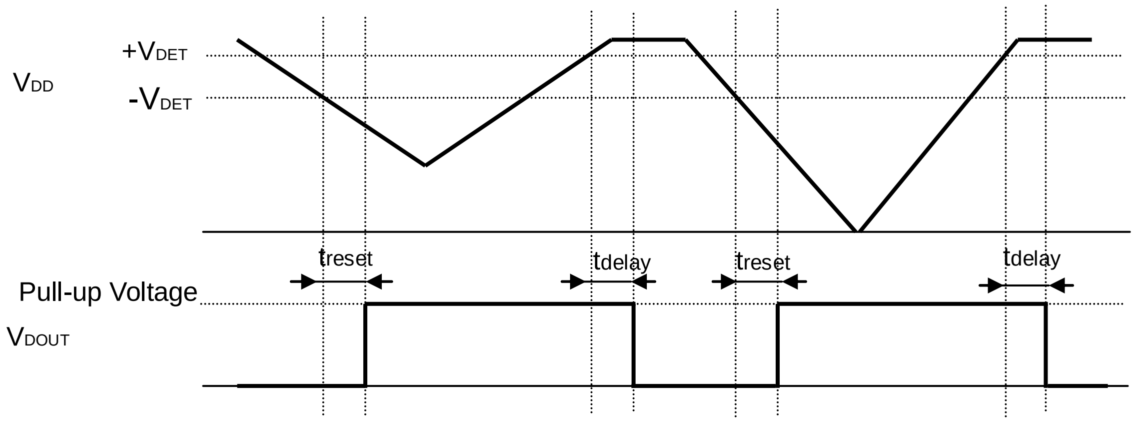
Figure E

TIMING CHART

R3150NxxxA/B (V_{DD} Voltage Detection Type)

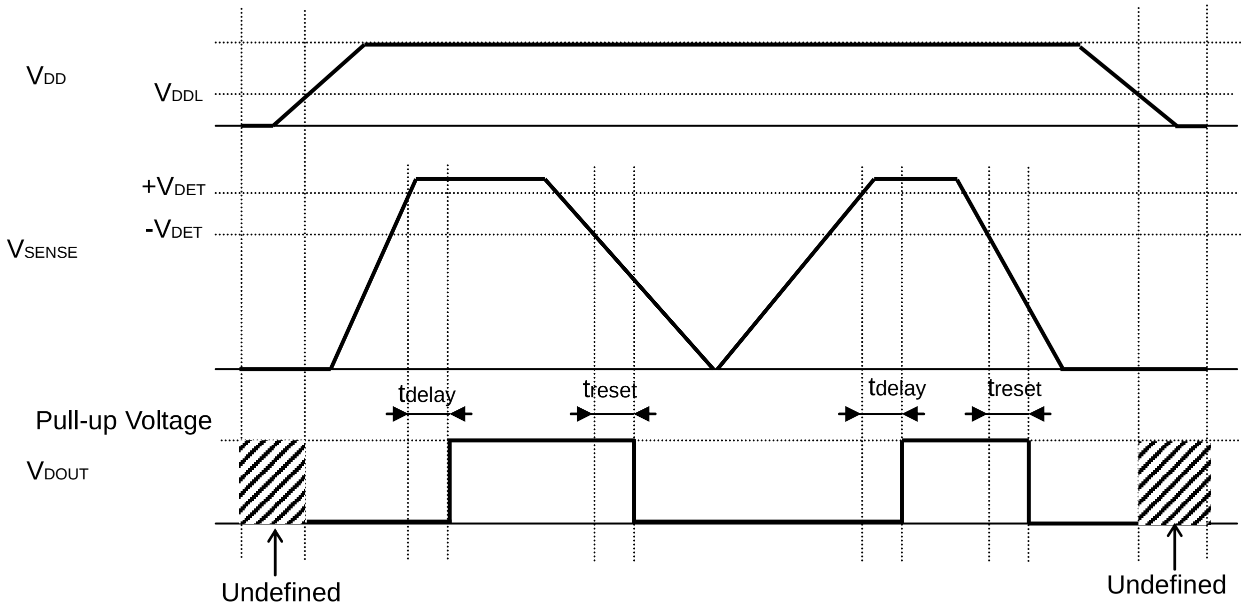


R3150NxxxA

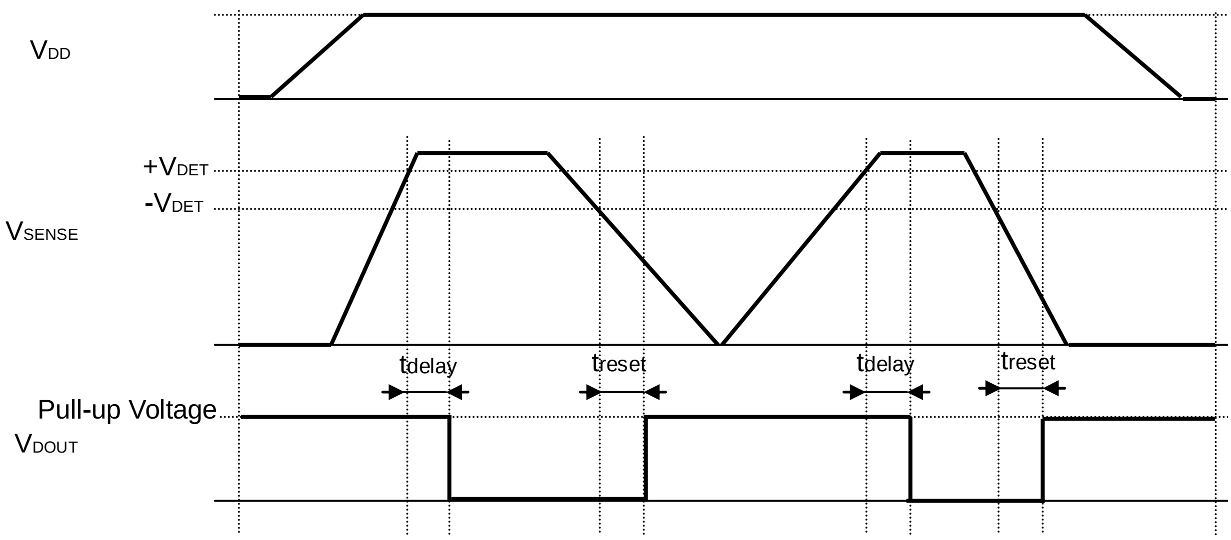


R3150NxxxB

R3150NxxxE/F (SENSE Voltage Detection Type)



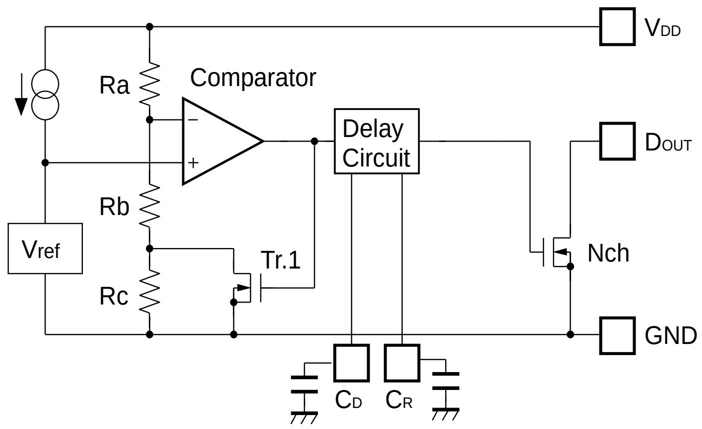
R3150NxxxE



R3150NxxxF

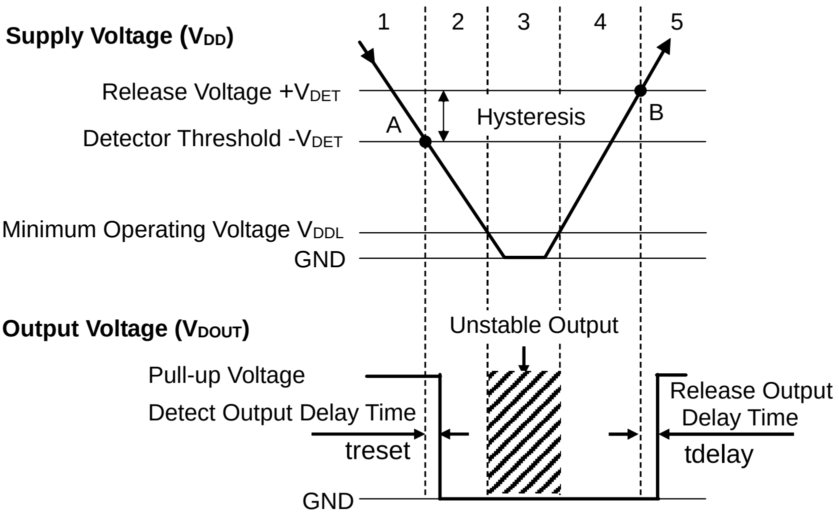
OPERATING DESCRIPTION

• R3150NxxxA (V_{DD} Voltage Detection Type)



*) D_{OUT} pin should be pulled-up to an external voltage level.

Block Diagram with External Capacitors



Step	1	2	3	4	5
Comparator (-) Pin Input Voltage	Ⅰ	Ⅱ	Ⅱ	Ⅱ	Ⅰ
Comparator Output	L	H	Unstable	H	L
Tr.1	OFF	ON	Unstable	ON	OFF
Output Tr. (Nch)	OFF	ON	Unstable	ON	OFF

Ⅰ $\frac{Rb+Rc}{Ra+Rb+Rc} x V_{DD}$

Ⅱ $\frac{Rb}{Ra+Rb} x V_{DD}$

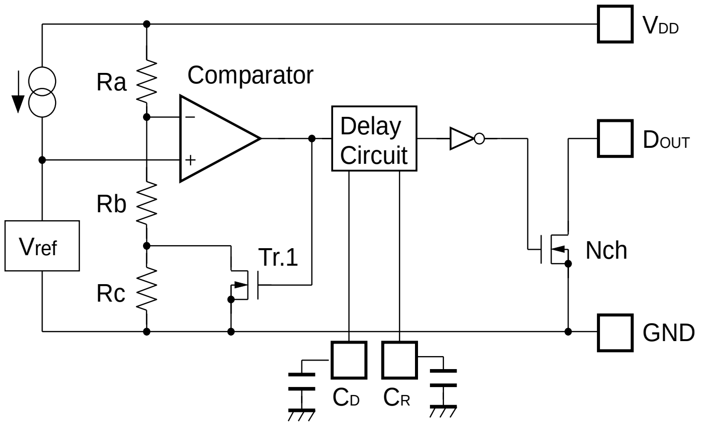
Operation Diagram

OPERATING CONDITIONS

1. The output voltage is equalized to the pull-up voltage.
2. The V_{DD} voltage drops to the detector threshold (A point) which means
   Vref ≥ V_{DD} x (Rb+Rc) / (Ra+Rb+Rc), and the comparator output shifts from “L” to “H” voltage, and the output pin voltage shifts from the pull-up voltage to “L” voltage.
3. If the V_{DD} voltage is lower than the minimum operating voltage, the output voltage becomes unstable.
4. The output pin voltage becomes “L” voltage.
5. The V_{DD} voltage becomes higher than the release voltage (B point) which means
   Vref ≤ V_{DD} x Rb / (Ra+Rb), and the comparator output shifts from “H” to “L” voltage, and the output pin voltage is equalized to the pull-up voltage.

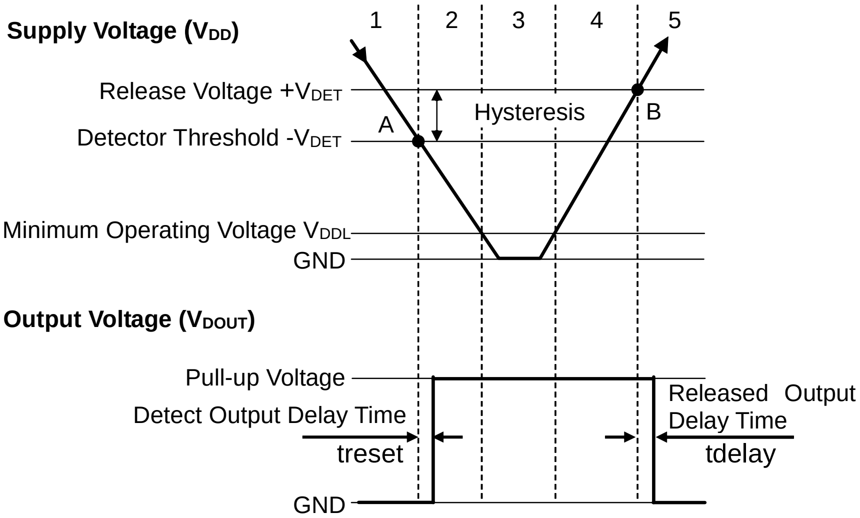
* The gap between the release voltage and the detector threshold is hysteresis.

• R3150NxxxB (V_{DD} Voltage Detection Type)



*) D_{OUT} pin should be pulled-up to an external voltage level.

Block Diagram with External Capacitors



Step	1	2	3	4	5
Comparator (-) Pin Input Voltage	I	II	II	II	I
Comparator Output	L	H	H	H	L
Tr.1	OFF	ON	ON	ON	OFF
Output Tr. (Nch)	ON	OFF	OFF	OFF	ON

I $\dfrac{Rb+Rc}{Ra+Rb+Rc} \times V_{DD}$

II $\dfrac{Rb}{Ra+Rb} \times V_{DD}$

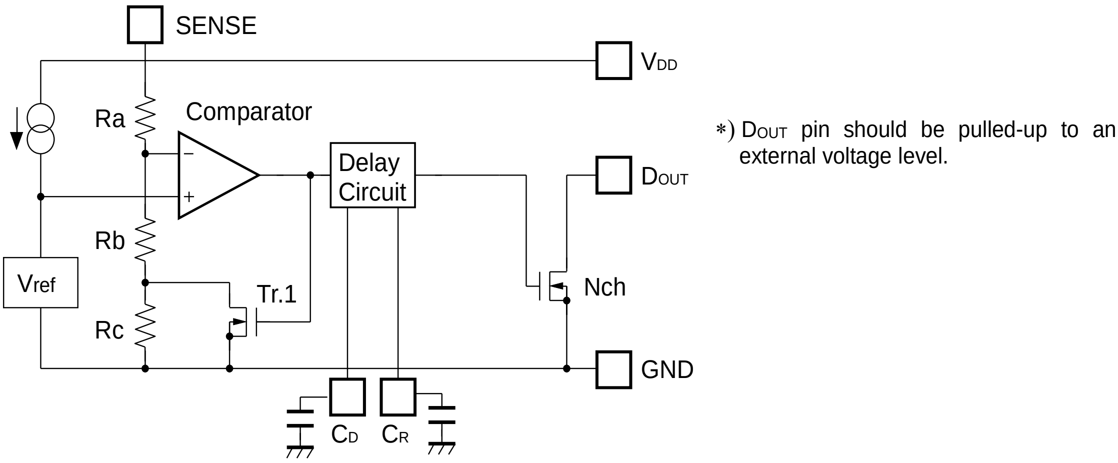
Operation Diagram

OPERATING CONDITIONS

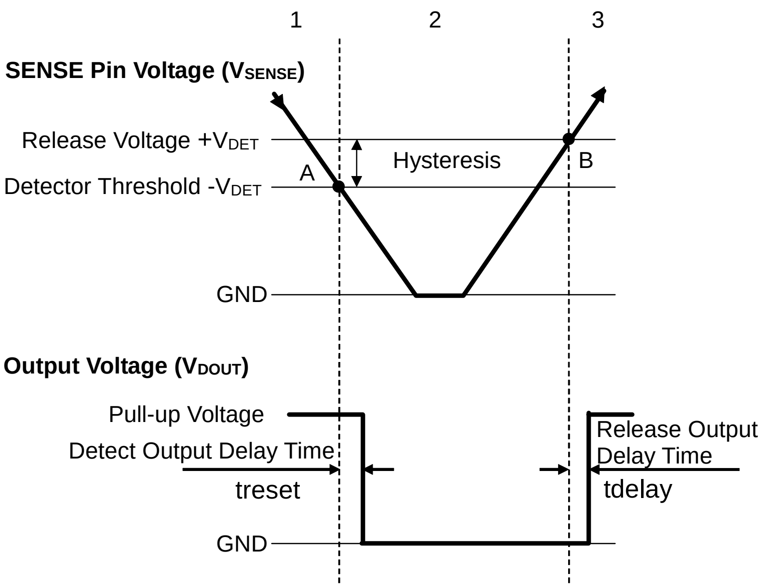
1. The output pin voltage becomes "L" voltage.
2. The V_{DD} voltage drops to the detector threshold (A point) which means Vref ≥ V_{DD} x (Rb+Rc) / (Ra+Rb+Rc), and the comparator output shifts from "L" to "H" voltage and the output voltage is equalized to the pull-up voltage.
3. If the V_{DD} voltage is lower than the minimum operating voltage, the output is the pull-up voltage.
4. The output voltage is equalized to the pull-up voltage.
5. The V_{DD} voltage becomes higher than the release voltage (B point) which means Vref ≤ V_{DD} x Rb / (Ra+Rb), and the comparator output shift from "H" to "L" voltage and the output voltage becomes "L" voltage.

* The gap between the release voltage and the detector threshold is hysteresis.

- **R3150NxxxE (SENSE Voltage Detection Type)**



Block Diagram with External Capacitors



Step	1	2	3
Comparator (-) Pin Input Voltage	I	II	I
Comparator Output	L	H	L
Tr.1	OFF	ON	OFF
Output Tr. (Nch)	OFF	ON	OFF

I $\dfrac{Rb+Rc}{Ra+Rb+Rc} \times V_{SENSE}$

II $\dfrac{Rb}{Ra+Rb} \times V_{SENSE}$

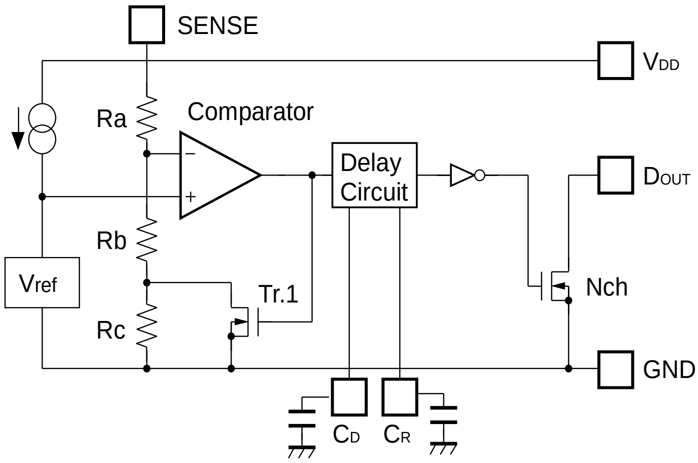
Operation Diagram

OPERATING CONDITIONS

1. The output voltage is equalized to the pull-up voltage.
2. The SENSE pin voltage drops to the detector threshold (A point) which means
   Vref ≥ V_{DD} x (Rb+Rc) / (Ra+Rb+Rc), and the comparator output shifts from “L” to “H” voltage, and the output pin voltage shifts from the pull-up voltage to “L” voltage. (If the V_{DD} voltage is higher than the minimum operating voltage, the output remains as “L” voltage)
3. The SNESE pin voltage becomes higher than the release voltage (B point) which means
   Vref ≤ V_{SENSE} x Rb / (Ra+Rb), and the comparator output shifts from “H” to “L” voltage, and the output pin voltage is equalized to the pull-up voltage.

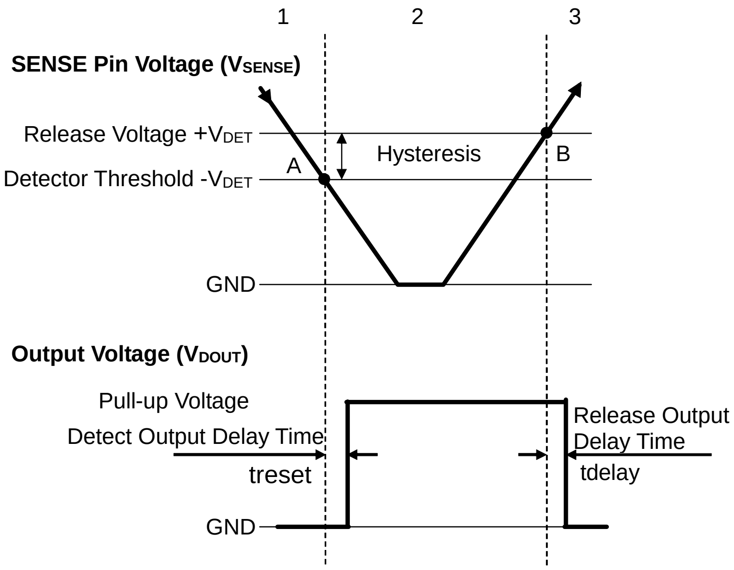
* The gap between the release voltage and the detector threshold is hysteresis.

- **R3150NxxxF (SENSE Voltage Detection Type)**



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

Block Diagram with External Capacitors



Step	1	2	3
Comparator (-) Pin Input Voltage	I	II	I
Comparator Output	L	H	L
Tr.1	OFF	ON	OFF
Output Tr. (Nch)	ON	OFF	ON

I $\dfrac{Rb+Rc}{Ra+Rb+Rc} \mathrm{x} V_{SENSE}$

II $\dfrac{Rb}{Ra+Rb} \mathrm{x} V_{SENSE}$

Operation Diagram

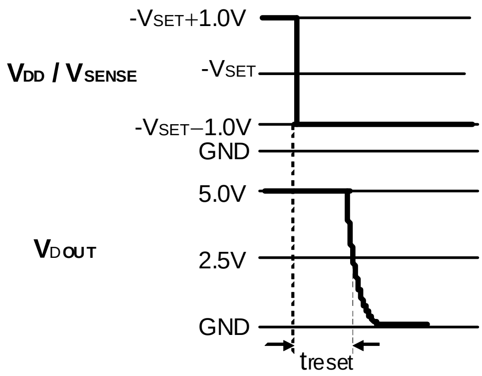
OPERATING CONDITIONS

1. The output becomes “L” voltage if the SENSE pin voltage is higher than the detector threshold.
2. The SENSE pin voltage drops to the detector threshold (A point) which means Vref ≥ V_{SENSE} x (Rb+Rc) / (Ra+Rb+Rc), and the comparator output shifts from “L” to “H” voltage and the output voltage is equalized to the pull-up voltage. (If the V_{DD} voltage is higher than the minimum operating voltage, the output remains as the pull-up voltage.)
3. The SENSE pin voltage becomes higher than the release voltage (B point) which means Vref ≤ V_{SENSE} x Rb / (Ra+Rb), and the comparator output shift from “H” to ”L” voltage and the output voltage becomes “L” voltage.

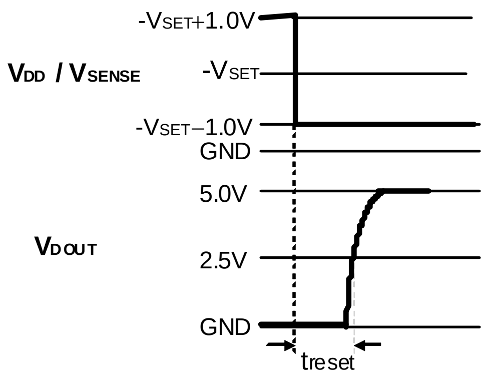
* The gap between the release voltage and the detector threshold is hysteresis.

DETECT OUTPUT DELAY TIME (treset)

Detect Output Delay Time (treset) is defined as follows:
treset starts after the output pin (D_{OUT}) is pulled up to 5V with a 100kΩ resistor and the V_{DD}/ V_{SENSE} is shifted from "-V_{SET} +1.0V" to "-V_{SET} -1.0V". treset ends when the output voltage reaches to 2.5V.



R3150NxxxA/E



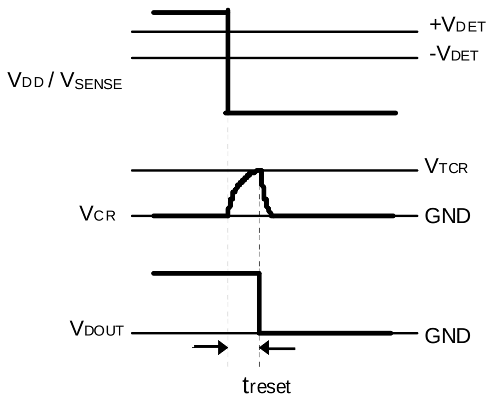
R3150NxxxB/F

treset is calculated by the following equation:

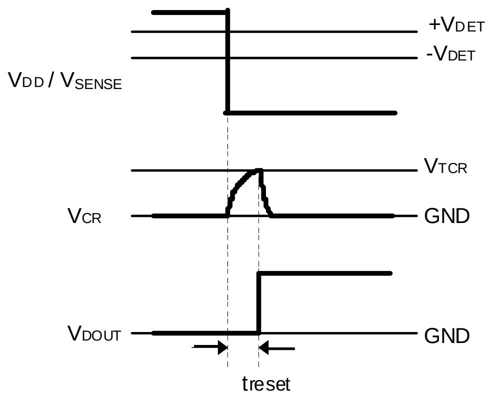
$$\text{treset (s)} = C_R \times 10^7$$

With the R3150NxxxA/ B, if the V_{DD} voltage after detection is 3.6V or less, the normal detect output delay time cannot be expected due to insufficient voltage (The detect output delay time decreases along with the decrease of V_{DD} voltage).

DETECT OUTPUT DELAY



R3150NxxxA/E

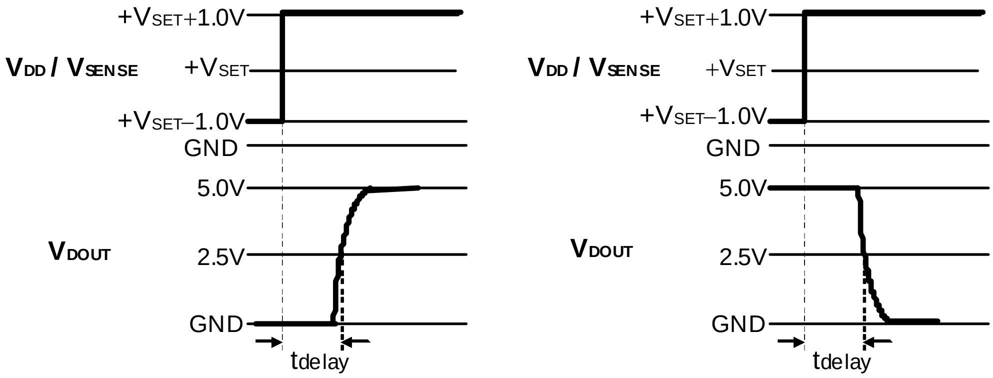


R3150NxxxB/F

If the voltage lower than the detector threshold is applied to V_{DD}/ SENSE pin while the voltage higher than the release voltage is applied to the V_{DD}/ SENSE pin, the external capacitor starts to charge electricity and the C_R pin voltage starts to increase.
Until the C_R pin voltage reaches to the detector threshold of the detect output delay pin (V_{TCR}), the output voltage maintains the release output. If the C_R pin voltage becomes higher than V_{TCR}, the output voltage shifts from the release output to the detection output.
In addition, if the output voltage shift from the release output to the detection output, the external capacitor starts to discharge electricity and the C_R pin voltage starts decrease.

RELEASE OUTPUT DELAY TIME (tdelay)

Release Output Delay Time (tdelay) is defined as follows:
tdelay starts after the output pin (D_{OUT}) is pulled up to 5V with a 100kΩ resistor, and the V_{DD}/ V_{SENSE} is shifted from "+V_{SET} -1.0V" to "+V_{SET} +1.0V". It ends when the output voltage reaches to 2.5V.

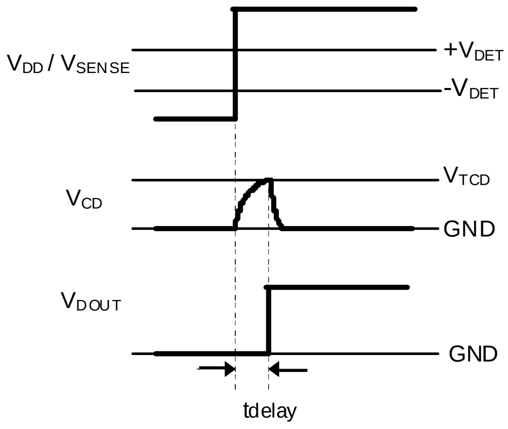


R3150NxxxA/E **R3150NxxxB/F**

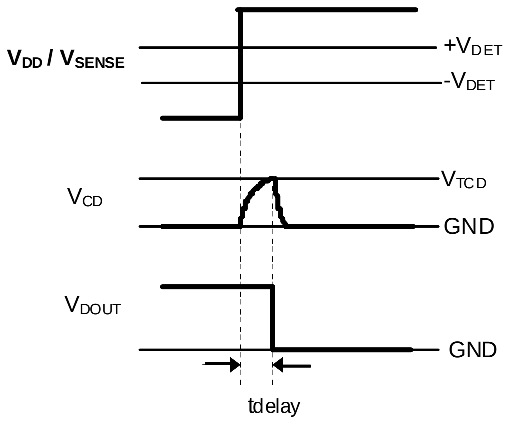
tdelay is calculated by the following equation:

$$\text{tdelay (s)} = C_D \times 10^7$$

RELEASE OUTPUT DELAY



R3150NxxxA/E



R3150NxxxB/F

If the voltage higher than the release voltage is applied to the V_{DD}/ SENSE pin while the voltage lower than the detector threshold is applied to V_{DD}/ SENSE pin, the external capacitor starts to charge electricity and the C_D pin voltage starts to increase.
Until the C_D pin voltage reaches to the release voltage of the release output delay pin (V_{TCD}), the output voltage maintains the release output. If the C_D pin voltage becomes higher than the release voltage of the release output delay pin, the output voltage shifts from the detection output to the release output.
In addition, if the output voltage shifts from the detection output to the release output, the external capacitor starts to discharge electricity and the C_D pin voltage starts to decrease.

START-UP AND SHUTDOWN SEQUENCES

The R3150NxxxE/ F (SENSE Voltage Detection Type) supervise the SENSE pin voltage while the voltage higher than the minimum operating voltage is applied to V_{DD} pin.
At start-up, either the V_{DD} pin or SENSE pin can be started up first, however, if the V_{DD} pin is started up with a voltage lower than the minimum operating voltage while the SENESE pin has already been started up, the start-up slope angle of the V_{DD} pin should be 10V/ ms or less.
At shutdown, the SNESE pin should be shut down first, then after treset, the V_{DD} pin should be shut down.

DETECTOR OPERATION VS. GLITCH INPUT VOLTAGE

The R3150N has built-in rejection of fast transients on the V_{DD} (R3150NxxxA/B) or SNESE (R3150NxxxE/F) pins. The rejection of transients depends on both the pulse width and the overdrive voltage, as shown in Figure 1.

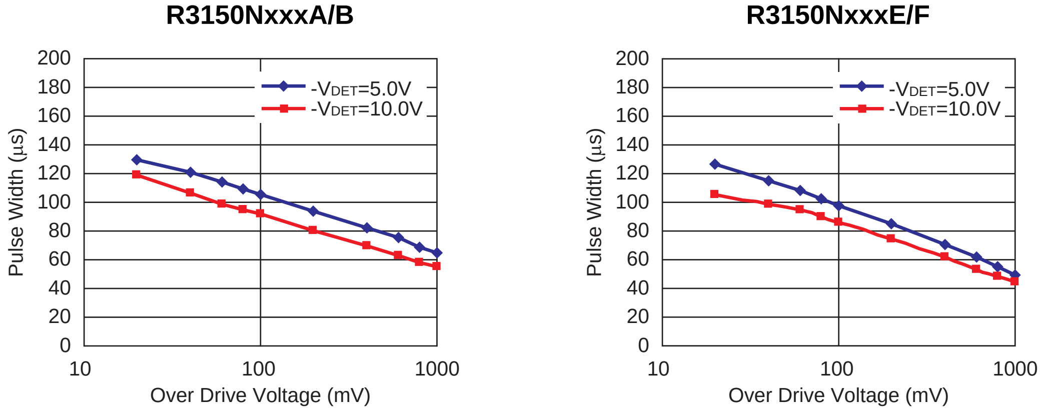


Figure 1. Minimum Pulse Width at V_{DD}/ SENSE vs. Overdrive Voltage

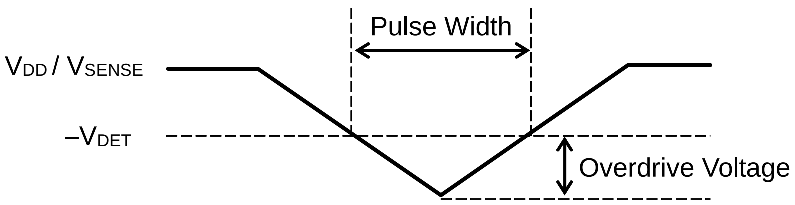


Figure 2. V_{DD} / V_{SENSE} Input Waveform

The R3150N does not respond to transients that are short pulse width / large overdrive voltage or long pulse width / small overdrive voltage. Any combination of pulse width and overdrive voltage above the curve generates a reset signal.
The overdrive voltage indicates between the minimum value of input voltage (V_{DD} or V_{SENSE}) and $-V_{DET}$, as shown in Figure 2.

RELEASE OPERATION VS. GLITCH INPUT VOLTAGE

The R3150N has built-in rejection of fast transients on the V_{DD} (R3150NxxxA/B) or SNESE (R3150NxxxE/F) pins. The rejection of transients depends on both the pulse width and the overdrive voltage, as shown in Figure 1.

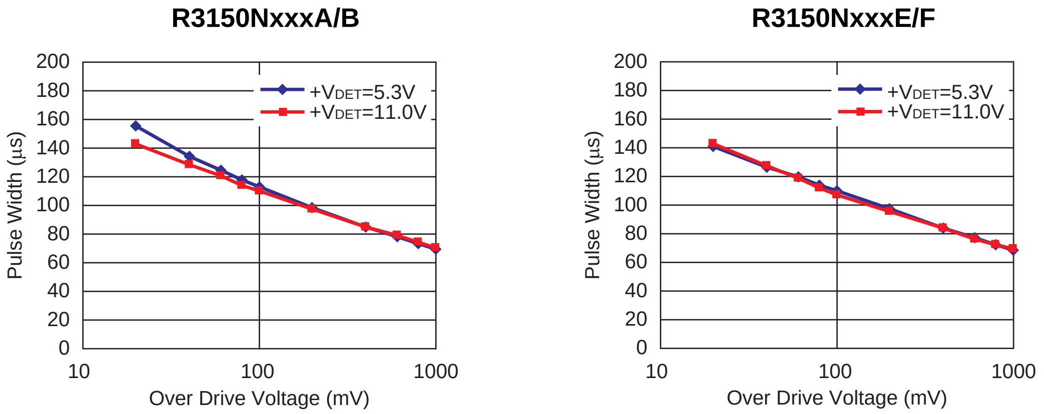


Figure 1. Minimum Pulse Width at V_{DD}/ SENSE vs. Overdrive Voltage

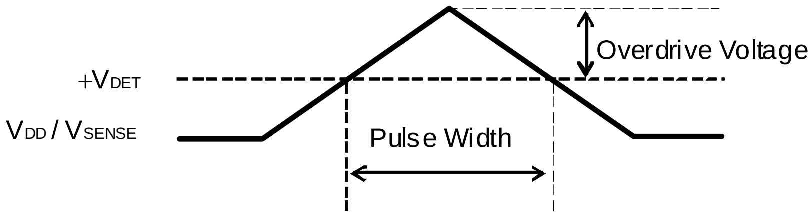


Figure 2. V_{DD} / V_{SENSE} Input Waveform

The R3150N does not respond to transients that are short pulse width / large overdrive voltage or long pulse width / small overdrive voltage. Any combination of pulse width and overdrive voltage above the curve generates a reset signal.

The overdrive voltage indicates between the maximum value of input voltage (V_{DD} or V_{SENSE}) and $+V_{DET}$, as shown in Figure 2.

PACKAGE INFORMATION

POWER DISSIPATION (SOT-23-6)

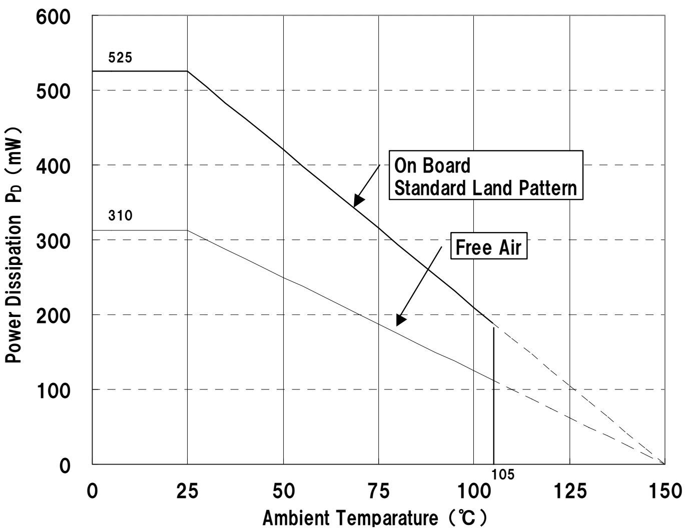
Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

Measurement Conditions

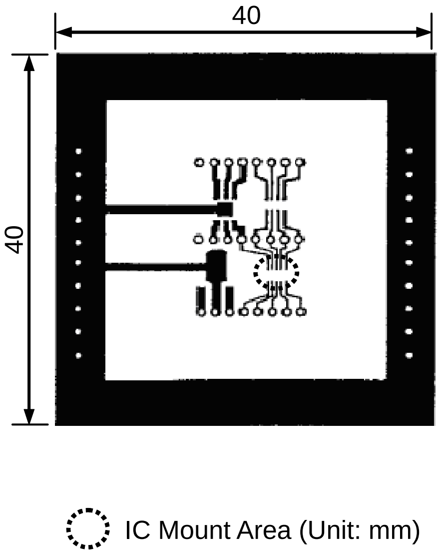
	Standard Test Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm x 40mm x 1.6mm
Copper Ratio	Top side: Approx. 50%, Back side: Approx. 50%
Through-holes	ϕ 0.5mm * 44pcs

Measurement Result: (Ta=25°C, Tjmax=150°C)

	Standard Test Land Pattern	Free Air
Power Dissipation	525mW	310mW
Thermal Resistance	θja = (150-25°C)/0.525W = 238°C/W	400°C/W

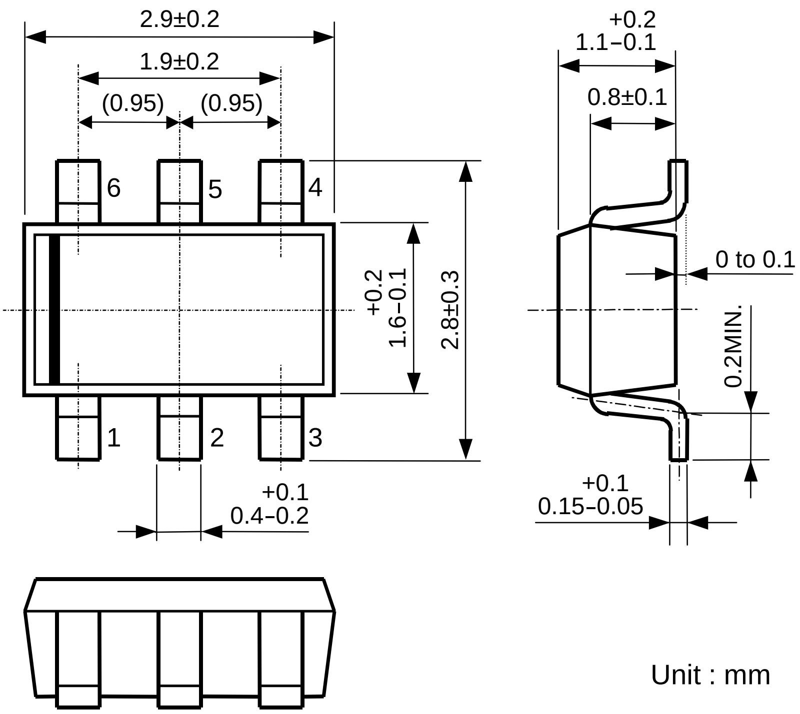


Power Dissipation



Measurement Board Pattern

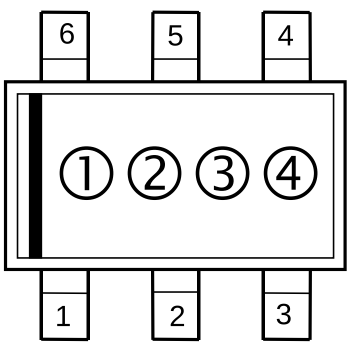
PACKAGE DIMENSIONS (SOT-23-6)



Unit : mm

MARK SPECIFICATION (SOT-23-6)

①②: Product Code ･･･ Refer to *MARK SPECFICATION TABLE*.
③④: Lot Number ･･･ Alphanumeric Serial Number



MARK SPECIFICATION TABLE (SOT-23-6)

R3150NxxxA

Product Name	① ②	Set Voltage	
		Detection	Release
R3150N001A	P F	6.4	7.3
R3150N002A	P G	8.5	9.0
R3150N003A	P H	9.0	9.5
R3150N004A	P J	5.9	6.8
R3150N005A	P K	6.5	7.1
R3150N006A	P L	6.3	6.9
R3150N007A	P M	5.8	6.3
R3150N018A	Z U	6.0	7.2

R3150NxxxB

Product Name	① ②	Set Voltage	
		Detection	Release
R3150N001B	P A	6.4	7.3
R3150N002B	P N	8.5	9.0
R3150N003B	P P	9.0	9.5
R3150N004B	P Q	5.9	6.8
R3150N005B	P R	6.5	7.1
R3150N006B	P S	6.3	6.9
R3150N007B	P T	5.8	6.3
R3150N008B	Z E	7.5	9.0
R3150N011B	Z G	7.8	9.0
R3150N012B	Z J	7.3	8.7
R3150N014B	Z M	8.1	8.5
R3150N015B	Z N	6.0	6.5
R3150N016B	Z Q	5.5	6.0
R3150N017B	Z S	5.3	6.3

R3150NxxxE

Product Name	① ②	Set Voltage	
		Detection	Release
R3150N001E	P U	6.4	7.3
R3150N002E	P V	8.5	9.0
R3150N003E	P W	9.0	9.5
R3150N004E	P X	5.9	6.8
R3150N005E	P Y	6.5	7.1
R3150N006E	P Z	6.3	6.9
R3150N007E	Z A	5.8	6.3
R3150N013E	Z L	7.0	7.5

R3150NxxxF

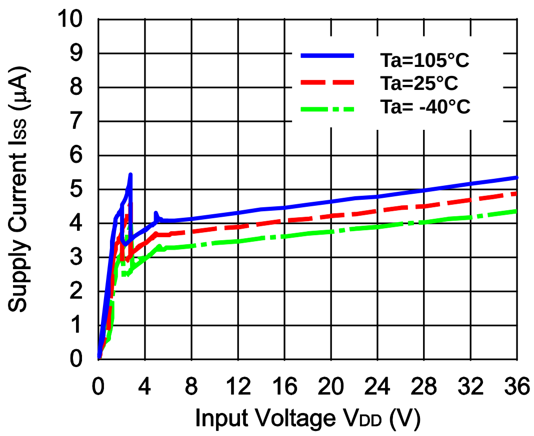
Product Name	① ②	Set Voltage	
		Detection	Release
R3150N001F	P B	6.4	7.3
R3150N002F	Z B	8.5	9.0
R3150N003F	Z C	9.0	9.5
R3150N004F	Z D	5.9	6.8
R3150N005F	P C	6.5	7.1
R3150N006F	P D	6.3	6.9
R3150N007F	P E	5.8	6.3
R3150N008F	Z F	7.5	9.0
R3150N011F	Z H	7.8	9.0
R3150N012F	Z K	7.3	8.7
R3150N015F	Z P	6.0	6.5
R3150N016F	Z R	5.5	6.0
R3150N017F	Z T	5.3	6.3

TYPICAL CHARACTERISTICS

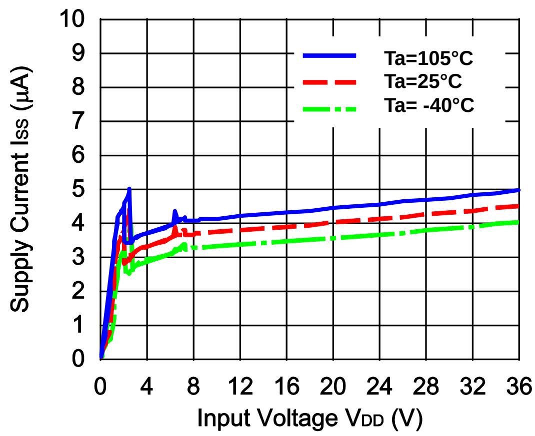
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

1) Supply Current vs. Input Voltage

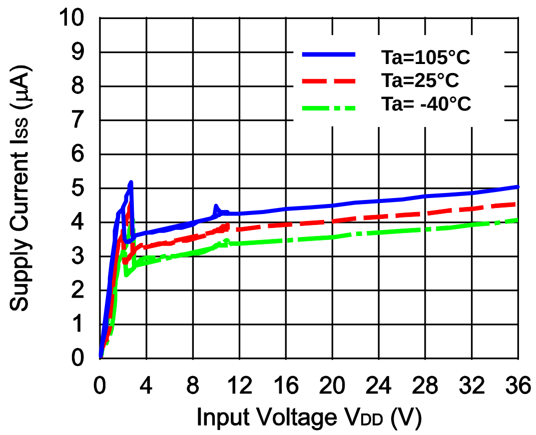
R3150NxxxA/ B (-V_{DET} =5.0V, +V_{DET} =5.3V)



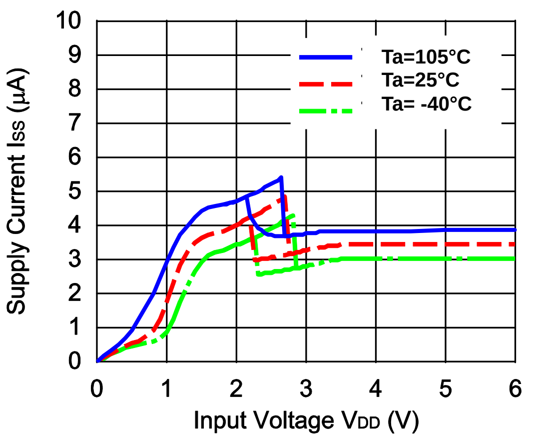
R3150NxxxA/ B (-V_{DET} =6.4V, +V_{DET} =7.3V)



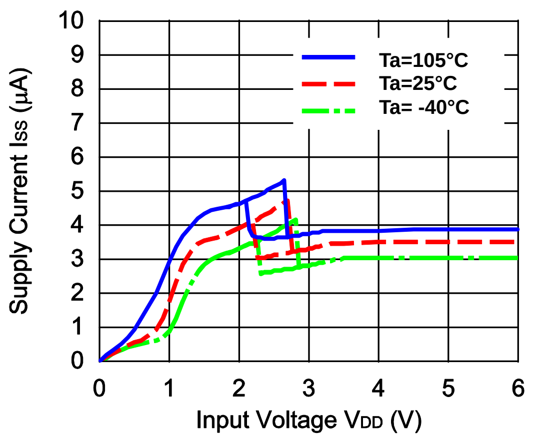
R3150NxxxA/ B (-V_{DET}=10.0V, +V_{DET}=11.0V)



R3150NxxxE/ F (V_{SENSE}=-V_{DET}−0.1V)

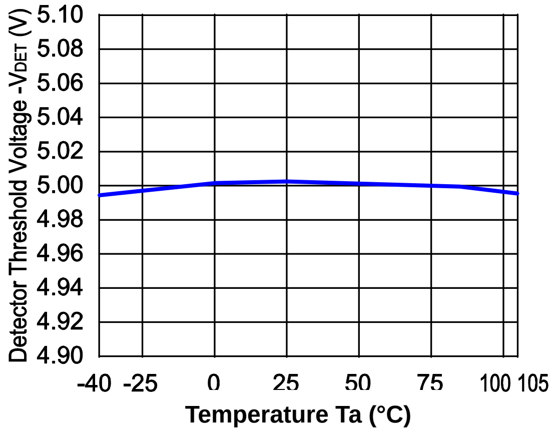


R3150NxxxE/ F (V_{SENSE}=+V_{DET}+0.1V)

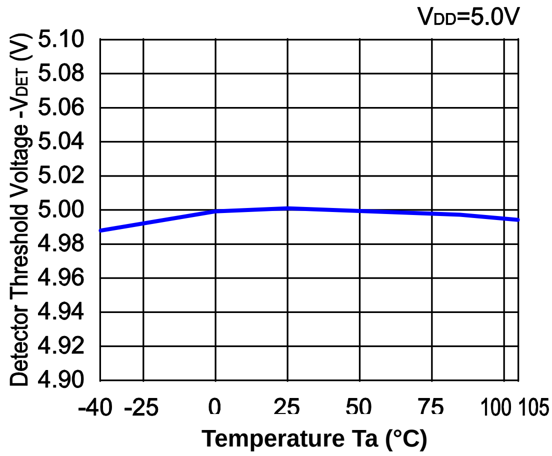


2) Detector Threshold vs. Temperature

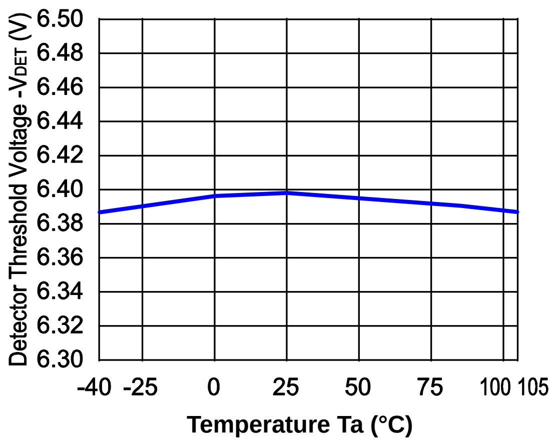
R3150NxxxA/ B (-V_{DET}=5.0V)



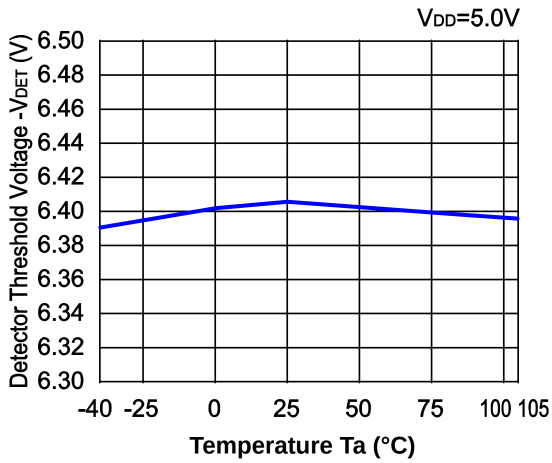
R3150NxxxE/ F (-V_{DET}=5.0V)



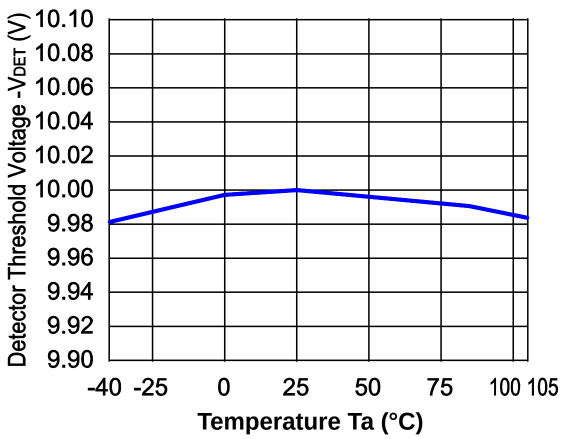
R3150NxxxA/ B (-V_{DET}=6.4V)



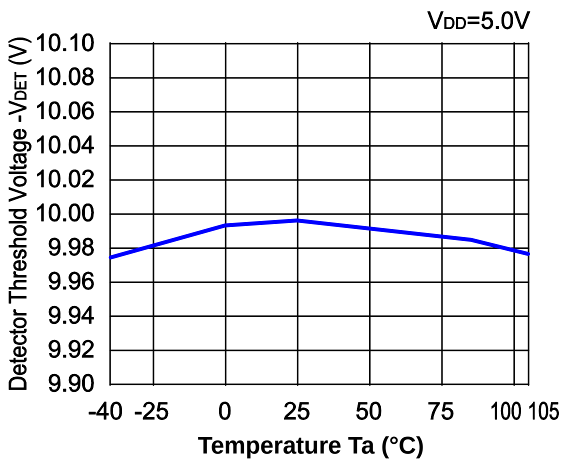
R3150NxxxE/ F (-V_{DET}=6.4V)



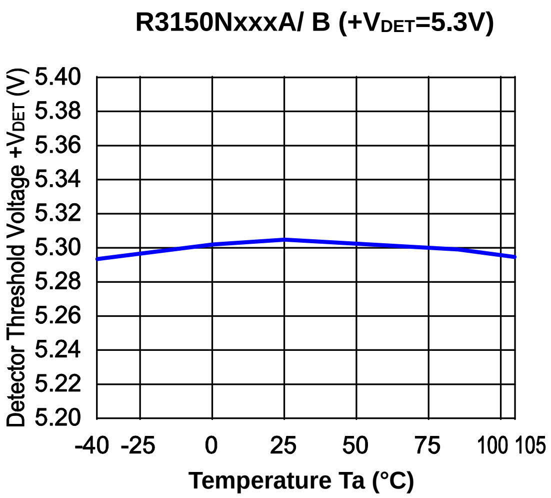
R3150NxxxA/ B (-V_{DET}=10.0V)

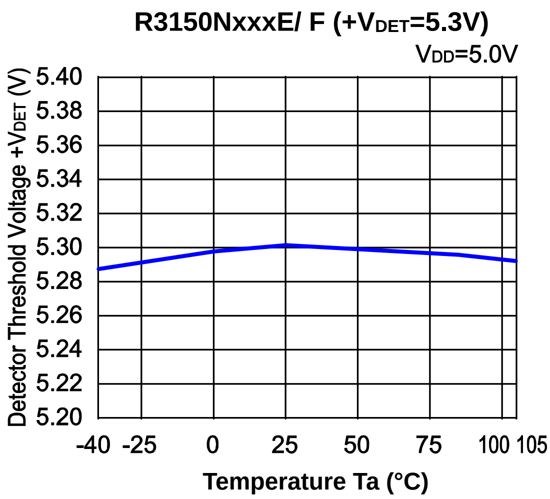


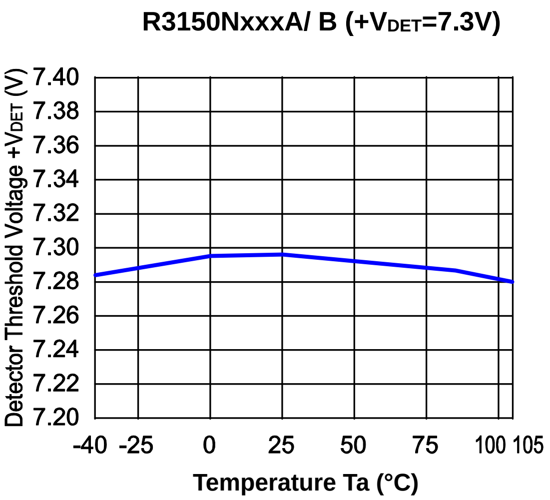
R3150NxxxE/ F (-V_{DET}=10.0V)

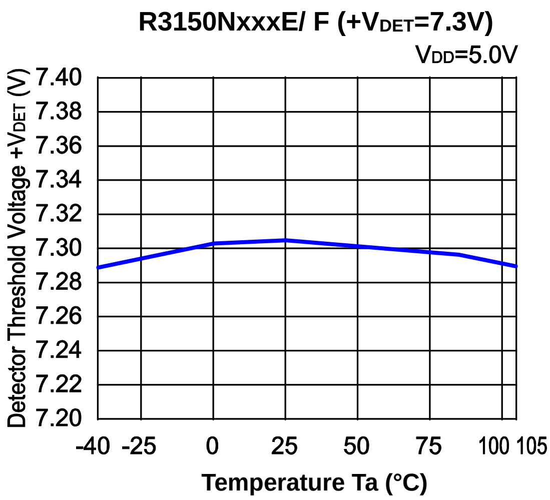


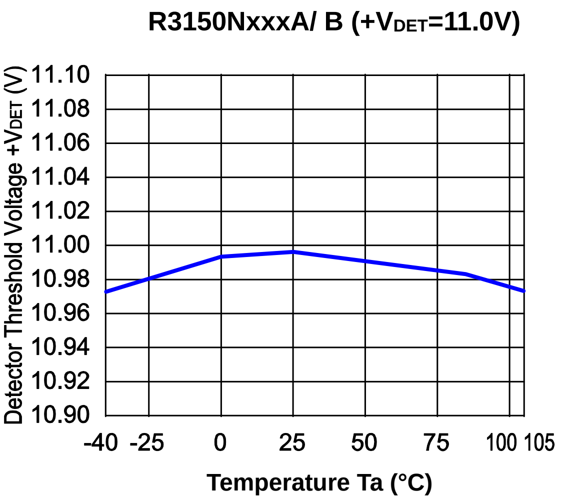
3) Release Voltage vs. Temperature

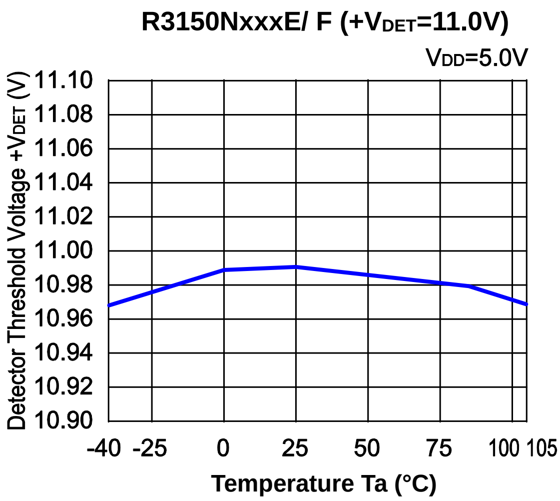






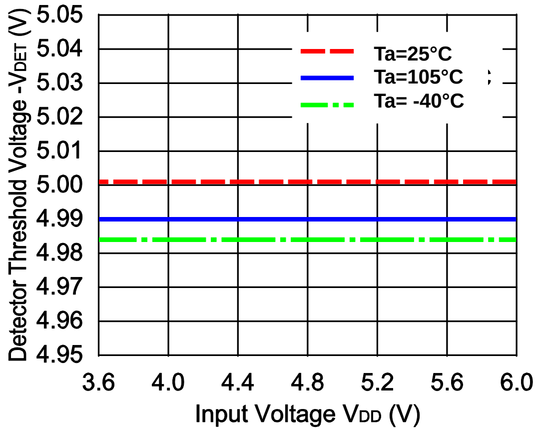




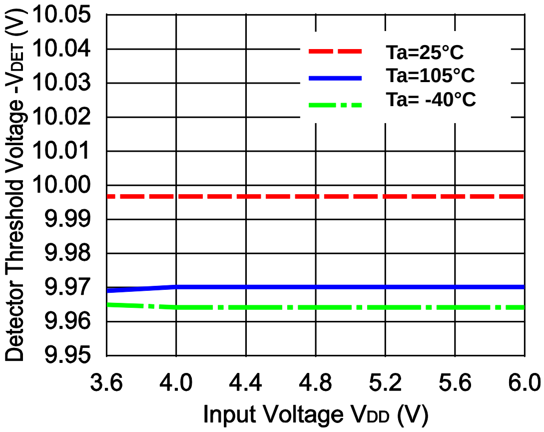


4) Detector Threshold vs. Input Voltage

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

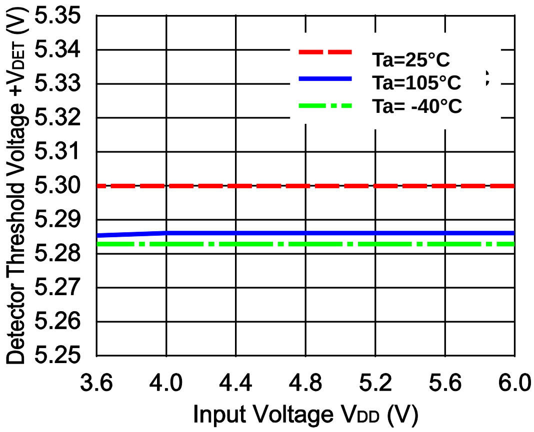


R3150NxxxE/ F (-V_{DET}=10.0V)

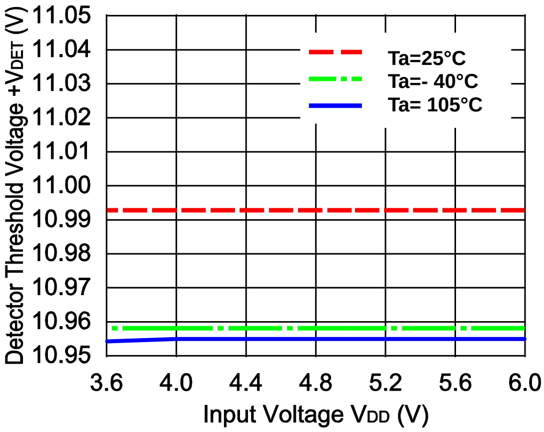


5) Release Voltage vs. Input Voltage

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

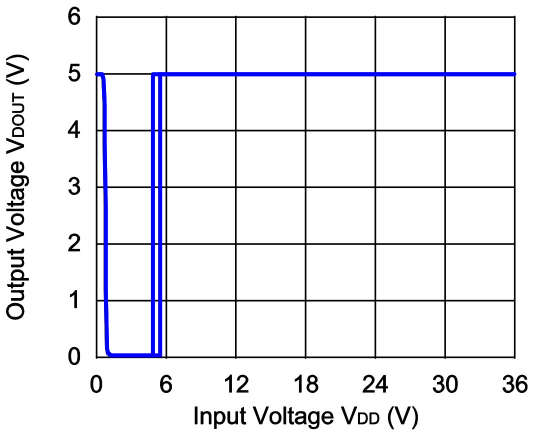


R3150NxxxE/ F (+V_{DET}=11.0V)

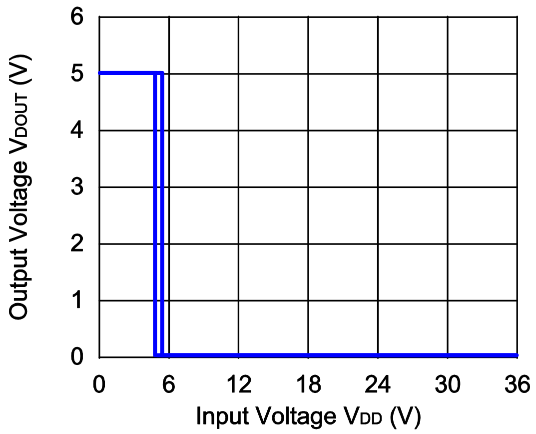


6) Output Voltage vs. Input Voltage（Ta=25°C, D_{OUT} pin is pulled-up to 5V and 100kΩ）

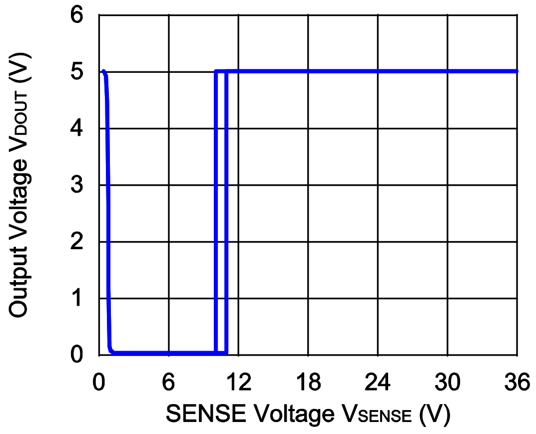
R3150NxxxA (-V_{DET}=5.0V, +V_{DET}=5.3V)



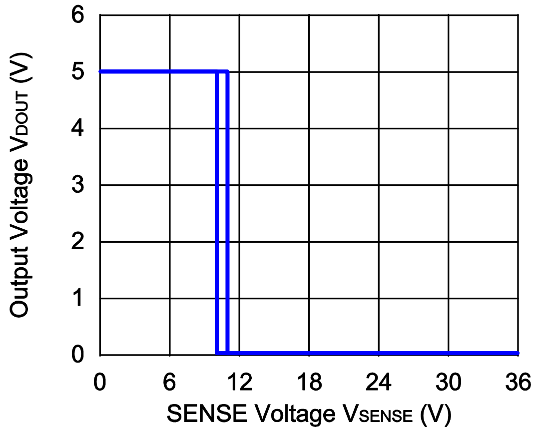
R3150NxxxB (-V_{DET}=5.0V, +V_{DET}=5.3V)



R3150NxxxA (-V_{DET}=10.0V, +V_{DET}=11.0V)

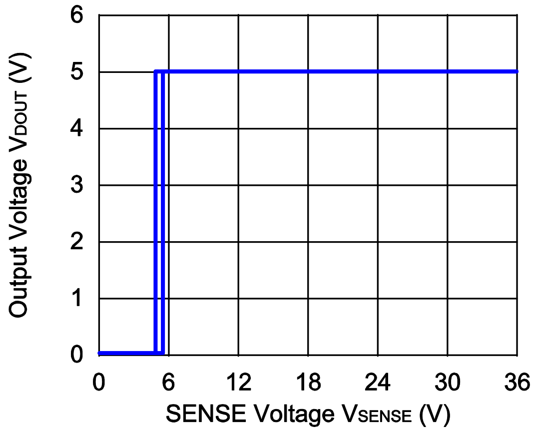


R3150NxxxB (-V_{DET}=10.0V, +V_{DET}=11.0V)

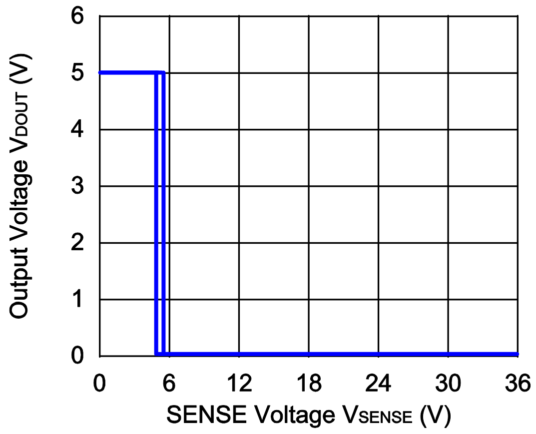


7) Output Voltage vs. SENSE pin Input Voltage (Ta=25°C, D_{OUT} pin is pulled-up to 5V and 100kΩ)

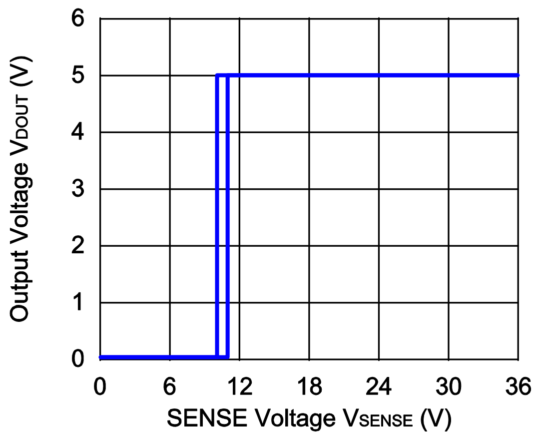
R3150NxxxE (-V_{DET}=5.0V, +V_{DET}=5.3V)



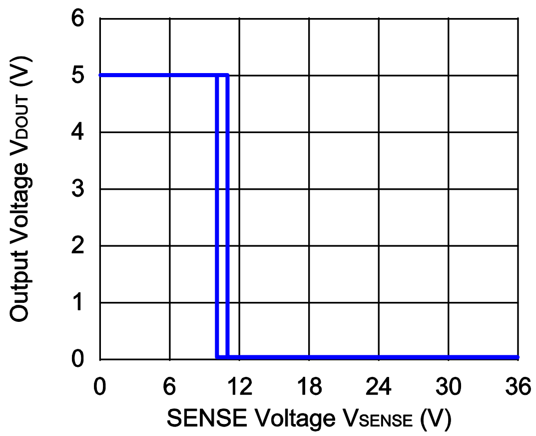
R3150NxxxF (-V_{DET}=5.0V, +V_{DET}=5.3V)



R3150NxxxE (-V_{DET}=10.0V, +V_{DET}=11.0V)

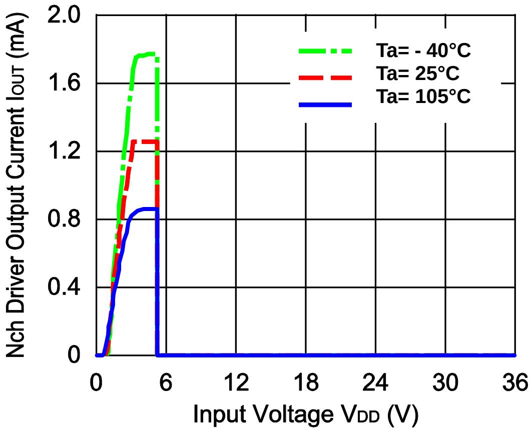


R3150NxxxF (-V_{DET}=10.0V, +V_{DET}=11.0V)

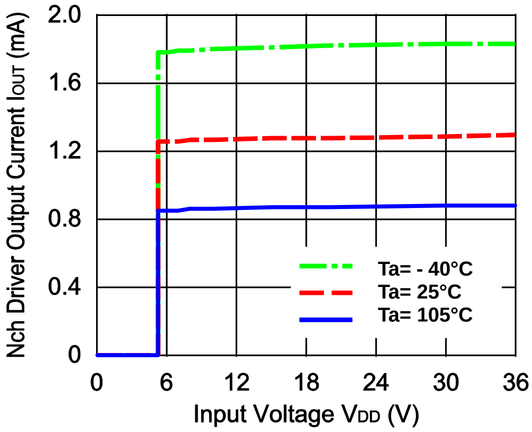


8) Nch Driver Output Current vs. Input Voltage

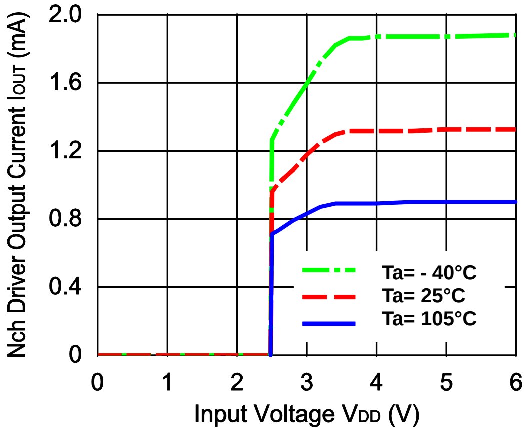
R3150NxxxA (+V_{DET}=5.3V, V_{DOUT}=0.05V)



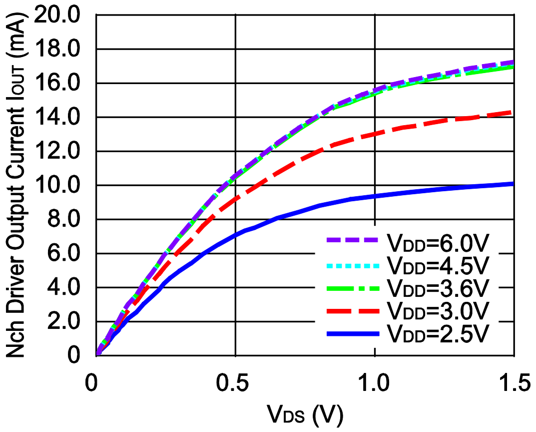
R3150NxxxB (+V_{DET}=5.3V, V_{DOUT}=0.05V)



R3150NxxxE (VSENSE=-VDET–1.0V, VDOUT=0.05V)
R3150NxxxF (VSENSE=+VDET+1.0V, VDOUT=0.05V)

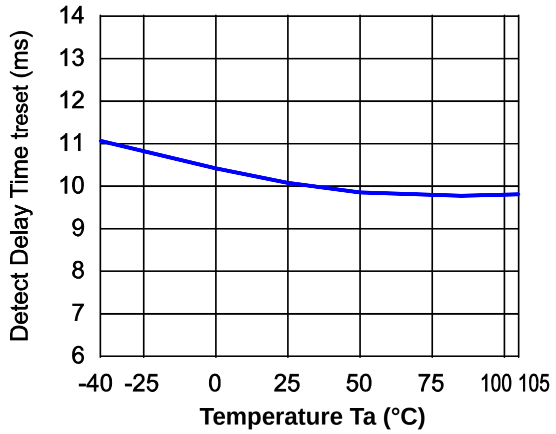


9) Nch Driver Output Current vs. V_{DS}

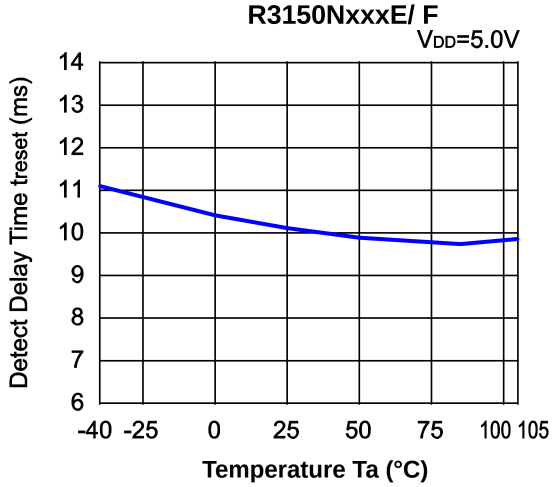


10) Output Reset Time vs. Temperature (C_R=1.0μF)

R3150NxxxA/ B

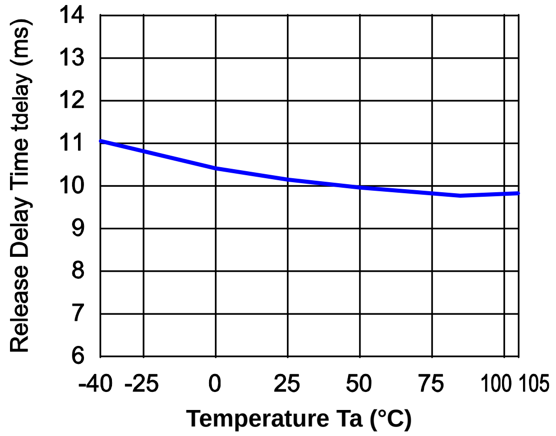


R3150NxxxE/ F

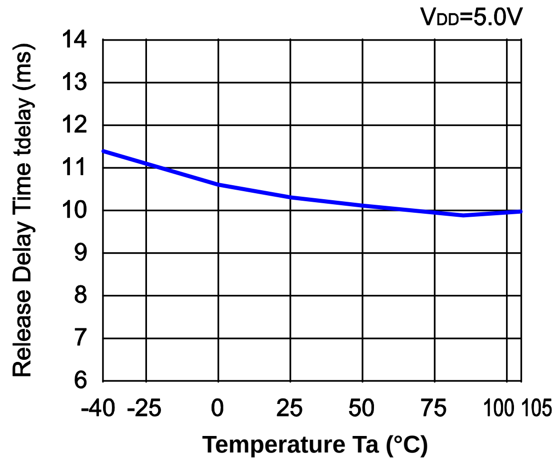


11) Output Delay Time vs. Temperature (C_D=1.0μF)

R3150NxxxA/ B

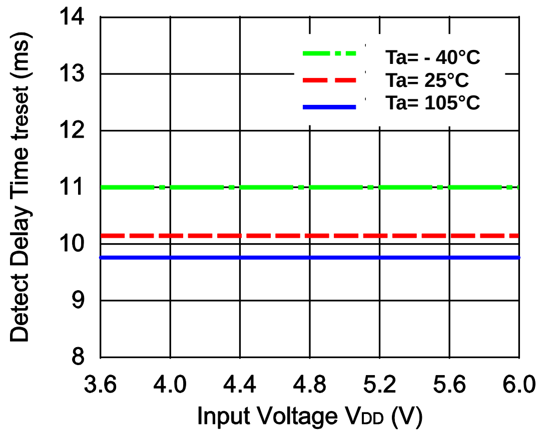


R3150NxxxE/ F



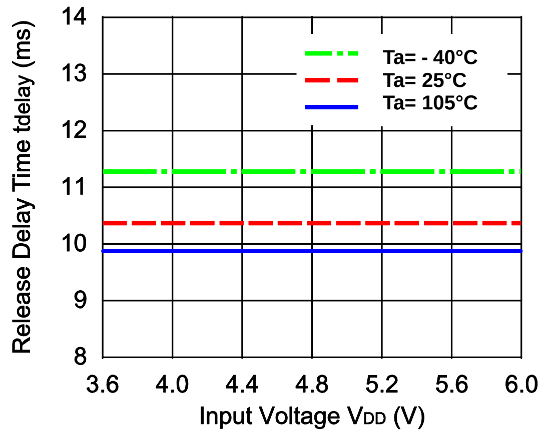
12) Detector Threshold vs. Input Voltage

R3150NxxxE/ F



13) Release Voltage vs. Input Voltage

R3150NxxxE/ F



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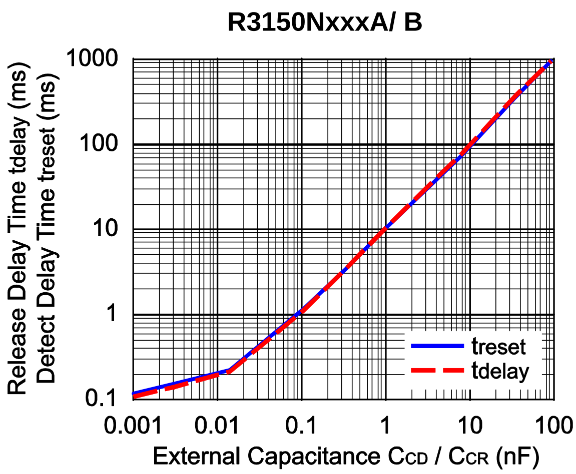
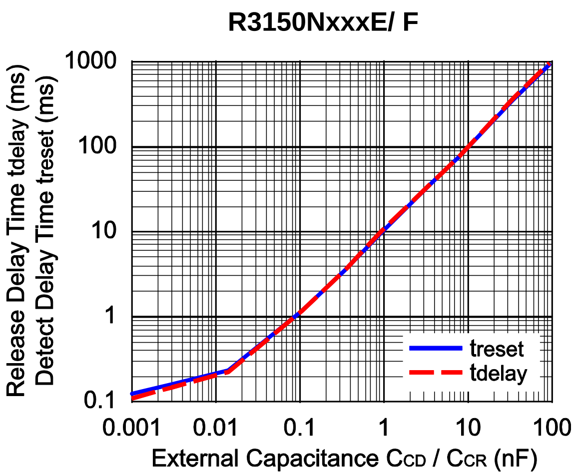
14) Detector or Release Delay Time vs. C_D pin C_R pin External Capacity (Ta=25°C)





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Sales & Support Offices

RICOH ELECTRONIC DEVICES CO., LTD.
Higashi-Shinagawa Office (International Sales)
3-32-3, Higashi-Shinagawa, Shinagawa-ku, Tokyo 140-8655, Japan
Phone: +81-3-5479-2857 Fax: +81-3-5479-0502

RICOH EUROPE (NETHERLANDS) B.V.
Semiconductor Support Centre
Prof. W.H. Keesomlaan 1, 1183 DJ Amstelveen, The Netherlands
Phone: +31-20-5474-309

RICOH INTERNATIONAL B.V. - German Branch
Semiconductor Sales and Support Centre
Oberrather Strasse 6, 40472 Düsseldorf, Germany
Phone: +49-211-6546-0

RICOH ELECTRONIC DEVICES KOREA CO., LTD.
3F, Haesung Bldg, 504, Teheran-ro, Gangnam-gu, Seoul, 135-725, Korea
Phone: +82-2-2135-5700 Fax: +82-2-2051-5713

RICOH ELECTRONIC DEVICES SHANGHAI CO., LTD.
Room 403, No.2 Building, No.690 Bibo Road, Pu Dong New District, Shanghai 201203, People's Republic of China
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

RICOH ELECTRONIC DEVICES CO., LTD.
Taipei office
Room 109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan (R.O.C.)
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623