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## 36V INPUT VOLTAGE DETECTOR

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NO.EA-187-111104

### OUTLINE

R3119N Series are CMOS-based 36V input (absolute maximum ratings: 50V) voltage detector with high detector threshold accuracy and ultra-low supply current. Each of those ICs consists of a voltage reference unit, a comparator, resistors for detector threshold setting, an output driver and a hysteresis circuit.

There are two types: R3119NxxxA has the  $C_D$  pin for setting the output delay time. R3119NxxxE has the SENSE pin.

The supply current of IC is only  $3.3\mu\text{A}$ . The detector threshold is fixed in the IC and can be set with a step of 0.1V in the range of 2.3V to 12V. Detector threshold accuracy is 1.5%. The output type is Nch Open drain type.

Since the package for these ICs is small SOT-23-5, high density mounting of the ICs on board is possible.

### FEATURES

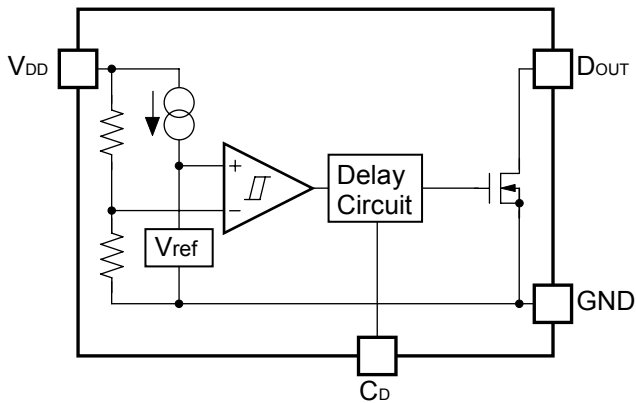
- Supply Current ..... Typ.  $3.3\mu\text{A}$
- Operating Voltage Range ..... 1.2V to 36.0V ( $C_D$  pin type: R3119NxxxA)  
2.1V to 6.0V (SENSE pin type: R3119NxxxE)
- Operating Temperature Range .....  $-40^\circ\text{C}$  to  $105^\circ\text{C}$
- Detector Threshold Range ..... 2.3V to 12.0V (0.1V steps)  
(For other voltages, please refer to MARK INFORMATION.)
- Detector Threshold Accuracy .....  $\pm 1.5\%$  ( $T_{\text{opt}}=25^\circ\text{C}$ )
- Temperature-Drift Coefficient of Detector Threshold ..... Typ.  $\pm 100\text{ppm}/^\circ\text{C}$
- Output Delay Time (Power ON Reset Delay Time) ..... Typ. 85ms ( $C_D=0.01\mu\text{F}$ ,  $C_D$  pin type)
- Output Delay Time Accuracy .....  $-50\%$  to  $80\%$  ( $C_D$  pin type: R3119NxxxA)
- Output Type ..... Nch Open Drain
- Package ..... SOT-23-5

### APPLICATIONS

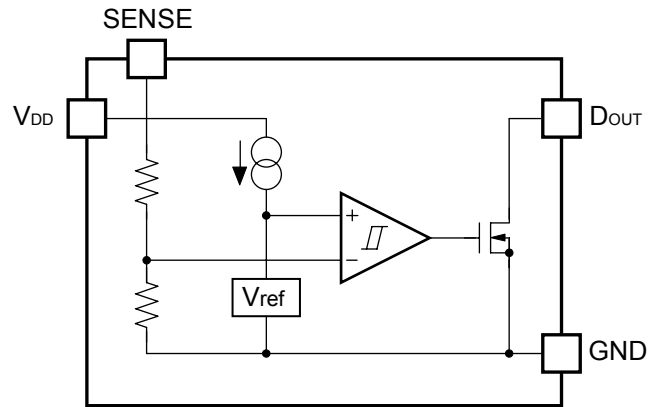
- CPU and Logic Circuit Reset
- Battery Checker
- Battery Back-up Circuit
- Power Failure Detector for Digital home appliances

## BLOCK DIAGRAMS

R3119NxxxA



R3119NxxxE

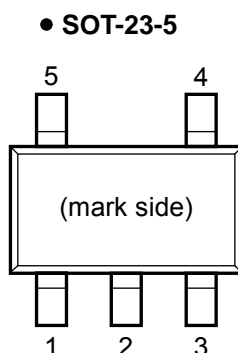


## SELECTION GUIDE

The package type, the detector threshold and the version for the ICs can be selected at the users' request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R3119Nxxx*-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes
xxx: The detector threshold can be designated in the range from 2.3V(023) to 12.0V(120) in 0.1V steps. (For other voltages, please refer to MARK INFORMATIONS.)				
* : Designation of Version (A) with C <sub>D</sub> pin type (E) with SENSE pin type				

## PIN CONFIGURATIONS



## PIN DESCRIPTIONS

### • SOT-23-5

Pin No.	Symbol	Description	
1	V <sub>DD</sub>	Input Pin	
2	GND*	Ground Pin	
3	GND*	Ground Pin	
4	D <sub>OUT</sub>	Output Pin ("L" at detection)	
5	C <sub>D</sub>	R3119NxxxA	Connecting pin with external capacitor for setting delay time
	SENSE	R3119NxxxE	Voltage Detector Voltage Sense Pin

\*) No. 2 and No.3 pins must be wired to the GND plane when it is mounted on board.

## ABSOLUTE MAXIMUM RATINGS

Symbol	Item		Rating	Unit
V <sub>DD</sub>	Supply Voltage	R3119NxxxA	-0.3 to 50.0	V
		R3119NxxxE	-0.3 to 7.0	
V <sub>OUT</sub>	Output Voltage (D <sub>OUT</sub> Pin)		-0.3 to 7.0	V
V <sub>CD</sub>	Output Voltage (C <sub>D</sub> Pin)	R3119NxxxA	-0.3 to 7.0	V
V <sub>SENSE</sub>	Input Voltage (SENSE Pin)	R3119NxxxE	-0.3 to 50.0	
I <sub>OUT</sub>	Output Current (D <sub>OUT</sub> Pin)		20	mA
P <sub>D</sub>	Power Dissipation (SOT-23-5)*		420	mW
T <sub>opt</sub>	Operating Temperature Range		-40 to 105	°C
T <sub>stg</sub>	Storage Temperature Range		-55 to 125	°C

\*) For Power Dissipation, please refer to PACKAGE INFORMATION.

### ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages 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 is not assured.

## ELECTRICAL CHARACTERISTICS

### • R3119NxxxA (C<sub>D</sub> pin type)

The specification in  is checked and guaranteed by design engineering at  $-40^{\circ}\text{C} \leq T_{\text{opt}} \leq 105^{\circ}\text{C}$ .

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
-V <sub>DET</sub>	Detector Threshold	V <sub>DD</sub> pin				V
			T <sub>opt</sub> =25°C	×0.985	×1.015	
			-40°C ≤ T <sub>opt</sub> ≤ 105°C	×0.970	×1.020	
V <sub>HYS</sub>	Detector Threshold Hysteresis		3.5	5	6.5	%
I <sub>SS</sub>	Supply Current	V <sub>DD</sub> = -V <sub>DET</sub> -0.1V		3.3	5.6	μA
		V <sub>DD</sub> = -V <sub>DET</sub> +1.0V		3.3	5.5	
V <sub>DDH</sub>	Maximum Operating Voltage				36	V
V <sub>DDL</sub>	Minimum Operating Voltage*	T <sub>opt</sub> =25°C			1.2	V
		-40°C ≤ T <sub>opt</sub> ≤ 105°C			1.25	
I <sub>OUT</sub>	Output Current (Driver Output Pin)	V <sub>DD</sub> =1.5V, V <sub>DS</sub> =0.05V	230			μA
		2.3V ≤ -V <sub>DET</sub> < 2.6V	V <sub>DD</sub> =2.2V V <sub>DS</sub> =0.5V	2.8		mA
		2.6V ≤ -V <sub>DET</sub> < 3.0V	V <sub>DD</sub> =2.5V V <sub>DS</sub> =0.5V	3.3		
		3.0V ≤ -V <sub>DET</sub>	V <sub>DD</sub> =2.9V V <sub>DS</sub> =0.5V	3.5		
I <sub>LEAK</sub>	Nch Driver Leakage Current	V <sub>DD</sub> =36V, V <sub>DS</sub> =6.0V			0.2	μA
Δ-V <sub>DET</sub> / ΔT <sub>opt</sub>	Detector Threshold Temperature Coefficient	-40°C ≤ T <sub>opt</sub> ≤ 105°C		±100		ppm/°C
t <sub>delay</sub>	Detector Output Delay Time	V <sub>DD</sub> =1.5V → -V <sub>DET</sub> +2.0V C <sub>D</sub> =0.01μF	45	85	150	ms

All of unit are tested and specified under load conditions such that T<sub>j</sub>≈T<sub>opt</sub>=25°C except for Detector Threshold Temperature Coefficient.

\*) This value is the minimum input voltage when the output voltage is 0.1V or less at detection.  
(The pull-up resistance; 100kΩ, the pull-up voltage; 5.0V)

### RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

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.

## R3119N

### • R3119NxxxE (SENSE pin type)

The specification in  is checked and guaranteed by design engineering at  $-40^{\circ}\text{C} \leq T_{\text{opt}} \leq 105^{\circ}\text{C}$ .

$T_{\text{opt}}=25^{\circ}\text{C}$

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
$V_{\text{DD}}$	Operating Voltage			2.1*		6	V
$-V_{\text{DET}}$	Detector Threshold	SENSE pin $V_{\text{DD}}=6\text{V}$	$T_{\text{opt}}=25^{\circ}\text{C}$	$\times 0.985$		$\times 1.015$	V
			$-40^{\circ}\text{C} \leq T_{\text{opt}} \leq 105^{\circ}\text{C}$	$\times 0.970$		$\times 1.020$	
$V_{\text{HYS}}$	Detector Threshold Hysteresis	$V_{\text{DD}}=6\text{V}$		3.5	5	6.5	%
$I_{\text{SS}}$	Supply Current	$V_{\text{DD}}=6\text{V}, V_{\text{SENSE}}=-V_{\text{DET}}-0.1\text{V}$			3.3	5.5	$\mu\text{A}$
		$V_{\text{DD}}=6\text{V}, V_{\text{SENSE}}=-V_{\text{DET}}+1.0\text{V}$			3.3	5.5	
$R_{\text{SENSE}}$	Sense Resistor			4.5		120	$\text{M}\Omega$
$I_{\text{OUT}}$	Output Current (Driver Output Pin)	$V_{\text{SENSE}} < -V_{\text{DET}}$	$V_{\text{DD}}=2.1\text{V}$ $V_{\text{DS}}=0.05\text{V}$	420			$\mu\text{A}$
		$V_{\text{SENSE}} < -V_{\text{DET}}$	$V_{\text{DD}}=2.2\text{V}$ $V_{\text{DS}}=0.5\text{V}$	2.8			mA
$I_{\text{LEAK}}$	Nch Driver Leakage Current	$V_{\text{DD}}=6\text{V}, V_{\text{SENSE}}=36\text{V}, V_{\text{DS}}=6.0\text{V}$				0.2	$\mu\text{A}$
$\frac{\Delta-V_{\text{DET}}}{\Delta T_{\text{opt}}}$	Detector Threshold Temperature Coefficient	$-40^{\circ}\text{C} \leq T_{\text{opt}} \leq 105^{\circ}\text{C}$			$\pm 100$		ppm/ $^{\circ}\text{C}$
$t_{\text{PLH}}$	Output Delay Time	$V_{\text{DD}}=6\text{V}$ $V_{\text{SENSE}}=1.5\text{V} \rightarrow -V_{\text{DET}}+2.0\text{V}$			15		$\mu\text{s}$
$V_{\text{SENSE}}$	Input Voltage (SENSE Pin)			0		36	V

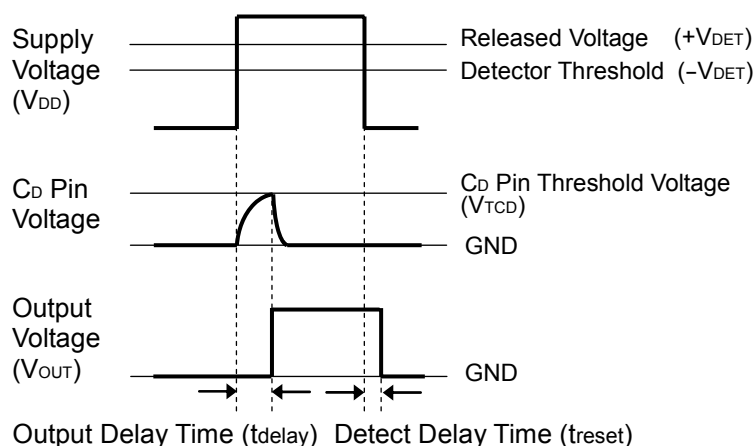
All of unit are tested and specified under load conditions such that  $T_j \approx T_{\text{opt}}=25^{\circ}\text{C}$  except for Detector Threshold Temperature Coefficient and Output Delay Time.

\*) Minimum operating voltage of "SENSE pin type" is minimum supply voltage to obtain correct detection voltage.

#### RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

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.

## TIMING CHART



When the supply voltage, which is higher than released voltage, is forced to  $V_{DD}$  pin, charge to an external capacitor starts, then  $C_D$  pin voltage increases. Until the  $C_D$  pin voltage reaches to  $C_D$  pin threshold voltage, output voltage maintains "L". When the  $C_D$  pin voltage becomes higher than  $C_D$  pin threshold voltage, output voltage is reversed from "L" to "H". Where the time interval between the rising edge of supply voltage and output voltage reverse point means output delay time.

When the output voltage reverses from "L" to "H", the external capacitor starts to discharge. Therefore, when lower voltage than the detector threshold voltage is forced to  $V_{DD}$  pin, the output voltage reverses from "H" to "L" thus the detect delay time is constant not being affected by the external capacitor.

### • Output Delay Time

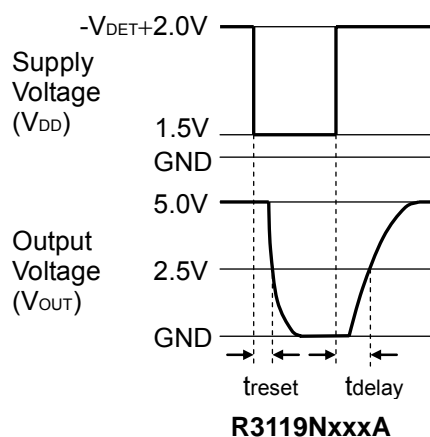
Output Delay Time ( $t_{delay}$ ) can be calculated with the next formula using the external capacitor:

$$t_{delay} (s) = 8.5 \times 10^6 \times C_D (F)$$

## DEFINITION OF OUTPUT DELAY TIME

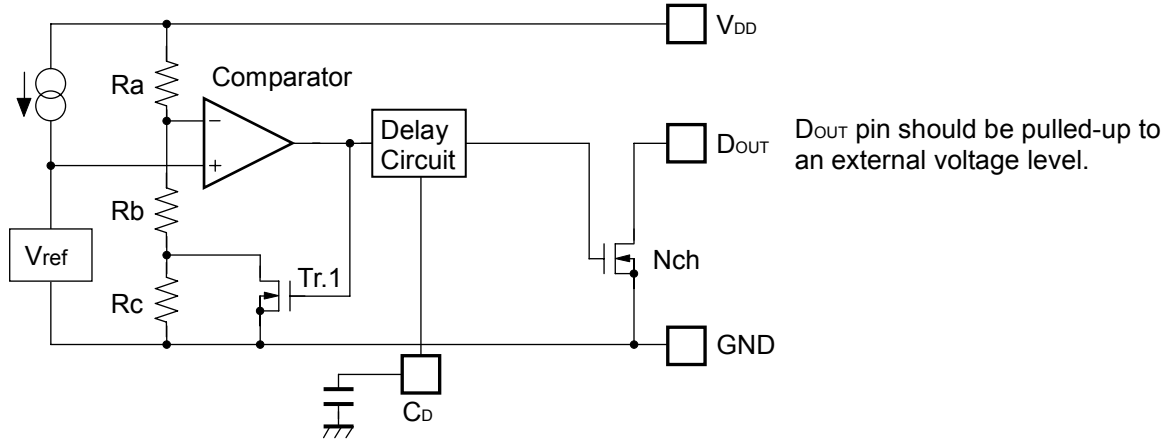
Output Delay Time ( $t_{delay}$ ) is defined as follows:

Under the condition of the output pin ( $D_{OUT}$ ) is pulled up through a resistor of  $100k\Omega$  to 5V, the time interval between the rising edge of  $V_{DD}$  pulse from 1.5V to  $(-V_{DET})+2.0V$  pulse voltage is supplied, the becoming of the output voltage to 2.5V.

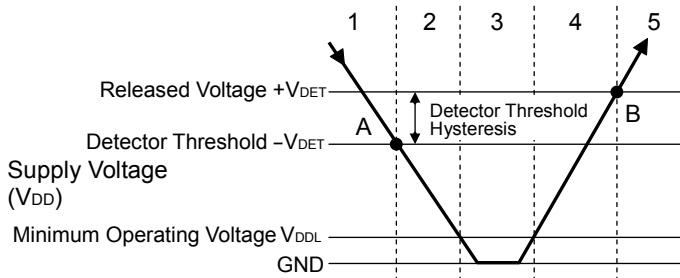


## OPERATION

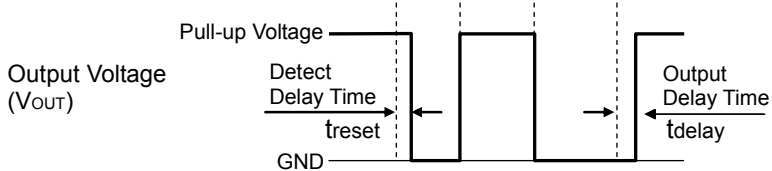
### • Operation of R3119NxxxA (C<sub>D</sub> pin type)



Block Diagram of External Capacitor Connection



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



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

$$II \quad \frac{Rb}{Ra+Rb} \times V_{DD}$$

Operation Diagram

### • Explanation of operation

Step 1. The output voltage is equal to the pull-up voltage.

Step 2. At Point "A",  $V_{ref} \geq V_{DD} \times (Rb+Rc) / (Ra+Rb+Rc)$  is true, as a result, the output of comparator is reversed from "L" to "H", therefore the output voltage becomes the GND level. The voltage level of Point A means a detector threshold voltage ( $-V_{DET}$ ).

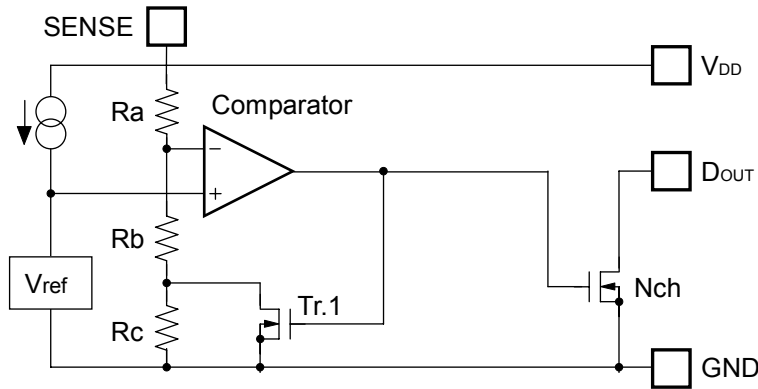
Step 3. When the supply voltage is lower than the minimum operating voltage, the operation of the output transistor becomes indefinite. The output voltage is equal to the pull-up voltage.

Step 4. The output voltage is equal to the GND level.

Step 5. At Point "B",  $V_{ref} \leq V_{DD} \times Rb / (Ra+Rb)$  is true, as a result, the output of comparator is reversed from "H" to "L", then the output voltage is equal to the pull-up voltage. The voltage level of Point B means a released voltage ( $+V_{DET}$ ).

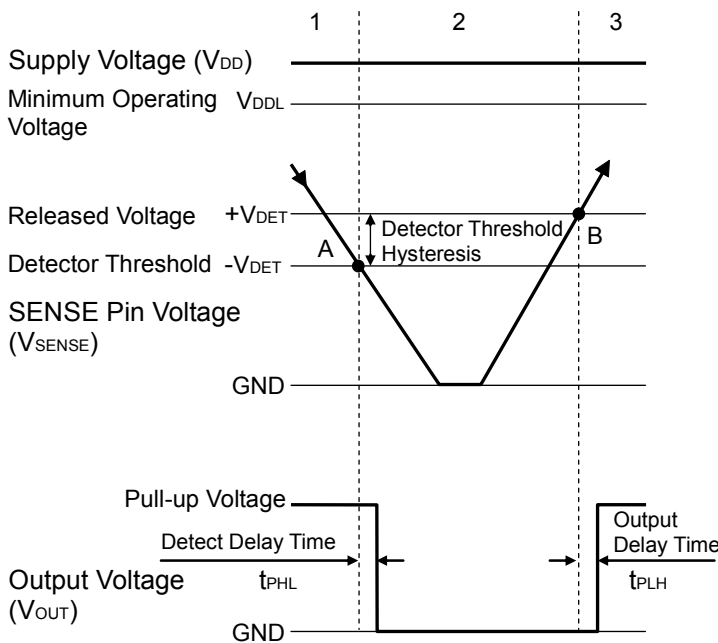
\*) The difference between a released voltage and a detector threshold voltage is a detector threshold hysteresis.

• Operation of R3119NxxxE (SENSE pin type)



D<sub>OUT</sub> pin should be pulled-up to an external voltage level.

Block Diagram



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

$$I \quad \frac{R_b + R_c}{R_a + R_b + R_c} \times V_{SENSE}$$

$$II \quad \frac{R_b}{R_a + R_b} \times V_{SENSE}$$

Operation Diagram

• Explanation of operation

Step 1. SENSE pin voltage is larger than detector threshold; the output voltage is equal to the pull-up voltage.

Step 2. At Point "A",  $V_{ref} \geq V_{SENSE} \times (R_b + R_c) / (R_a + R_b + R_c)$  is true, as a result, the output of comparator is reversed from "L" to "H", therefore the output voltage becomes the GND level. The voltage level of Point A means a detector threshold voltage (-V<sub>DET</sub>). (When the supply voltage is higher than the minimum operating voltage, the output voltage is equal to the GND level.)

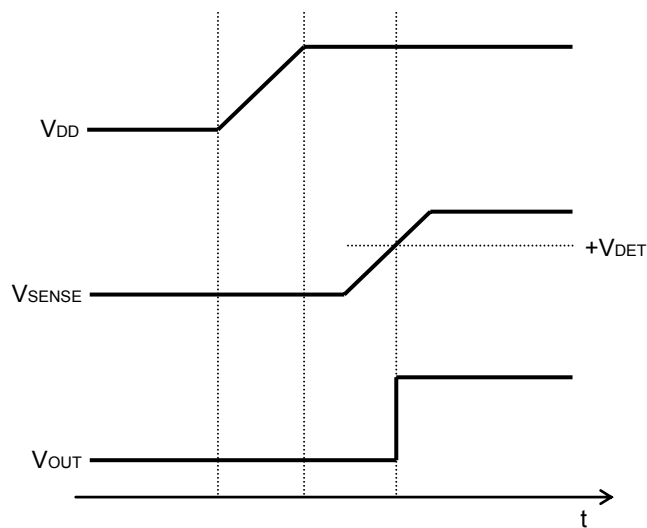
Step 3. At Point "B",  $V_{ref} \leq V_{SENSE} \times R_b / (R_a + R_b)$  is true, as a result, the output of comparator is reversed from "H" to "L", then the output voltage is equal to the pull-up voltage. The voltage level of Point B means a released voltage (+V<sub>DET</sub>).

\*) The difference between a released voltage and a detector threshold voltage is a detector threshold hysteresis.

## Power supply injection order

The R3119NxxxE Series supervise the voltage of the SENSE pin.  $V_{DD}$  pin and SENSE pin can be used at the same voltage level. Likewise,  $V_{DD}$  pin and SENSE pin can be used at the different voltage level. If the  $V_{DD}$  pin and SENSE pin are used at different voltage level, regarding the start-up sequence, force the voltage level to  $V_{DD}$  pin prior to the SENSE pin.

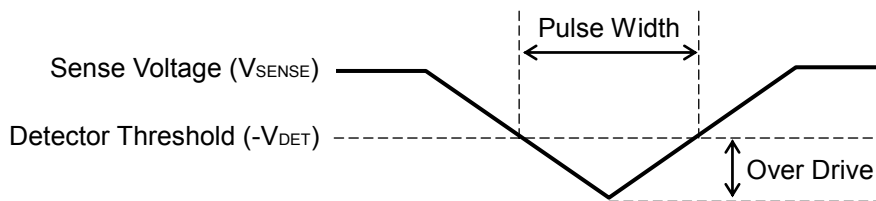
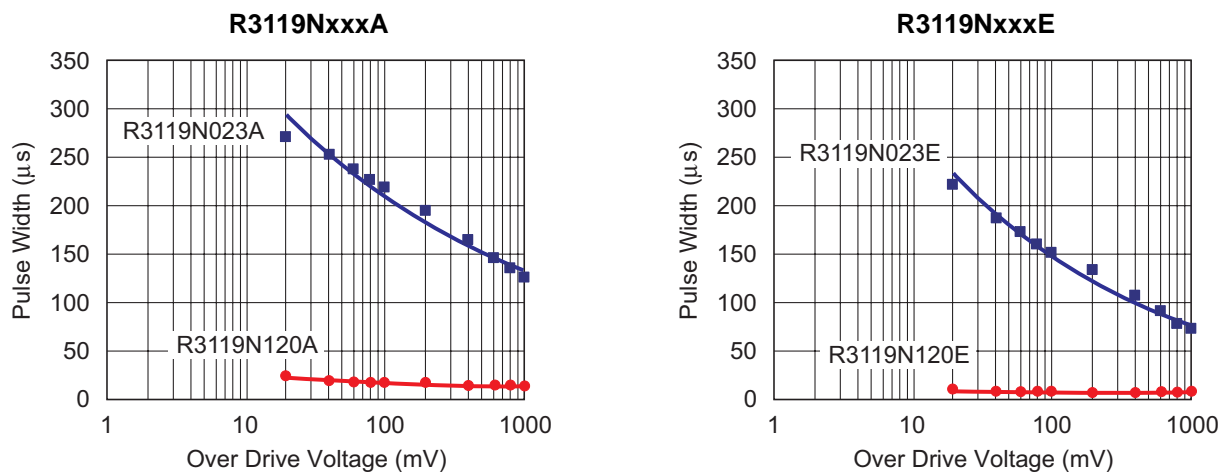
If the SENSE pin voltage is equal or more than the released voltage ( $+V_{DET}$ ),  $D_{OUT}$  pin becomes "H"(Fig.1). Besides, a voltage beyond  $V_{DD}$  pin is also acceptable to SENSE pin.



**Fig.1 Turn on sequence**

## Detector Operation vs. glitch input voltage to the V<sub>DD</sub> pin or SENSE pin

When the R3119N is at released, if the pulse voltage which the detector threshold or lower voltage, the graph below means that the relation between pulse width and the amplitude of the swing to keep the released state for the R3119N.



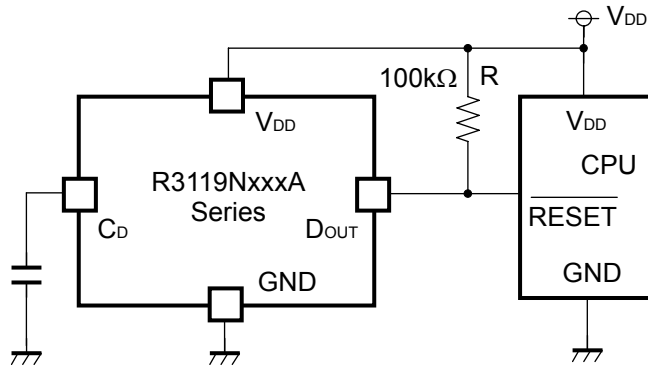
**V<sub>SENSE</sub> Input Waveform**

This graph shows the maximum pulse conditions to keep the released voltage. If the pulse with larger amplitude or wider width than the graph above, is input to the V<sub>DD</sub> pin (R3119NxxxA) or to the SENSE pin (R3119NxxxE), the reset signal may be output.

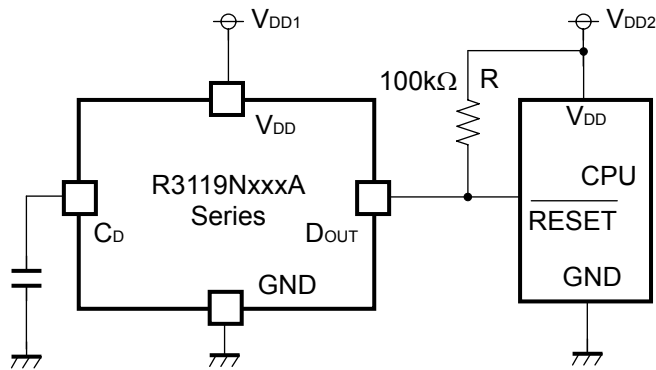
## TYPICAL APPLICATION

- **R3119NxxxA (C<sub>D</sub> pin type)**

(1) Input Voltage to R3119NxxxA is equal to Input Voltage to CPU

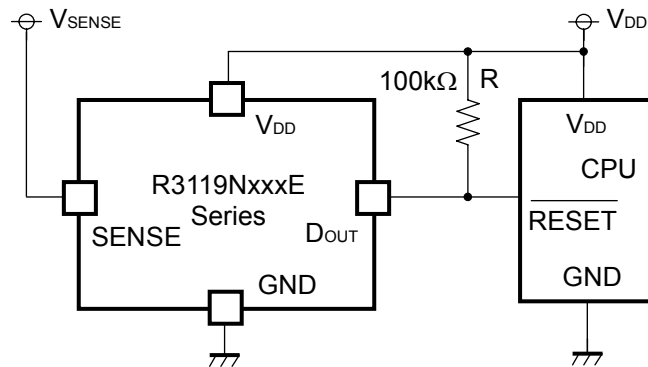


(2) Input Voltage to R3119NxxxA is unequal to Input Voltage to CPU

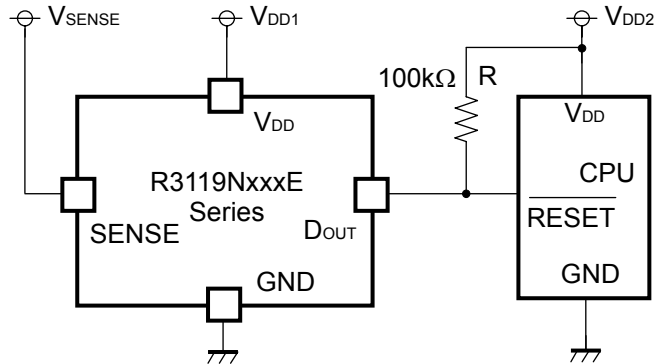


- **R3119NxxxE (SENSE pin type)**

(1) Input Voltage to R3119NxxxE is equal to Input Voltage to CPU

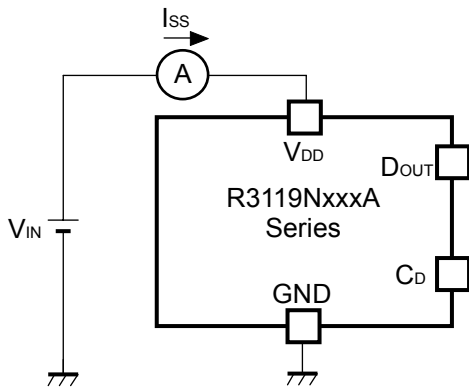


(2) Input Voltage to R3119NxxxE is unequal to Input Voltage to CPU

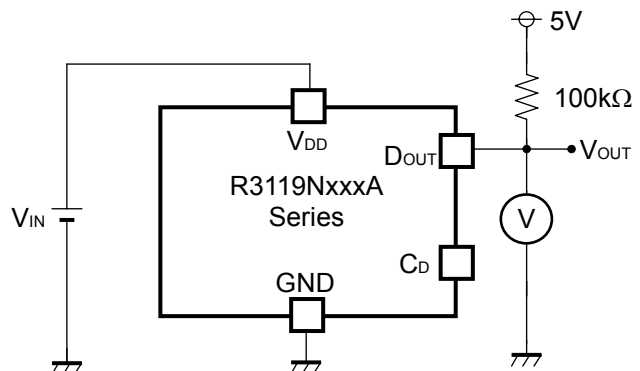


TEST CIRCUITS

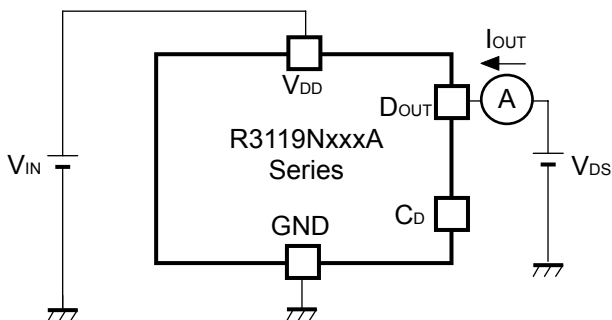
- R3119NxxxA (C<sub>D</sub> pin type)



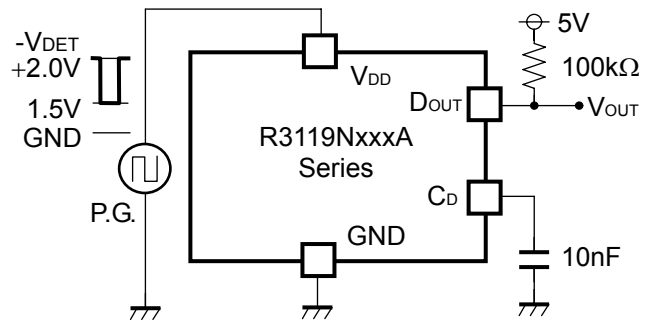
Supply Current Test Circuit



Detector Threshold Test Circuit



Nch Driver Output Current Test Circuit

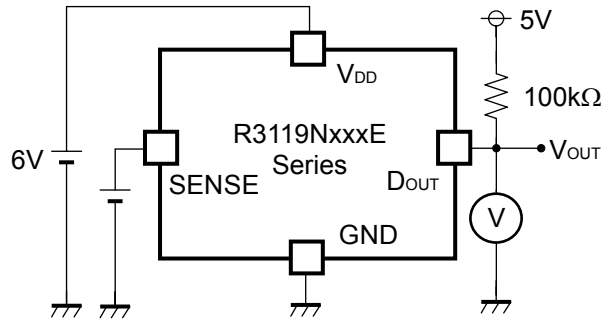


Output Delay Time Test Circuit

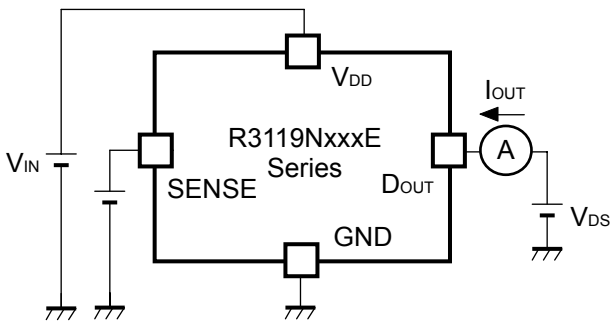
• R3119NxxxE (SENSE pin type)



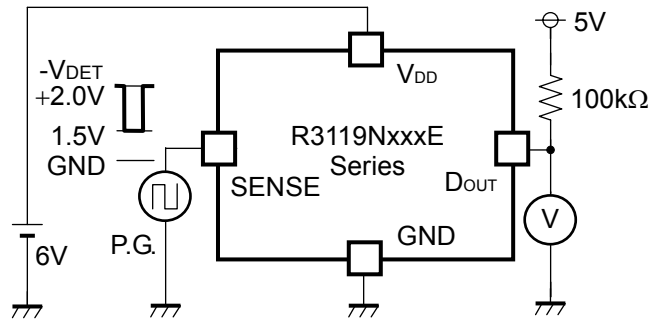
Supply Current Test Circuit



Detector Threshold Test Circuit



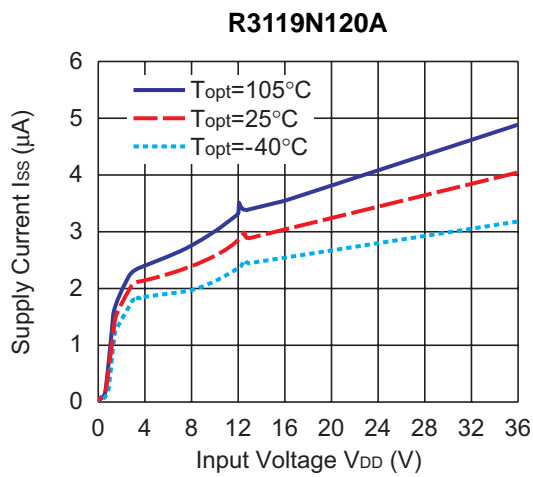
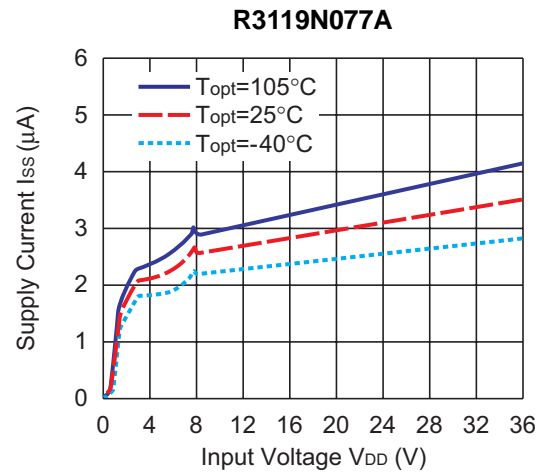
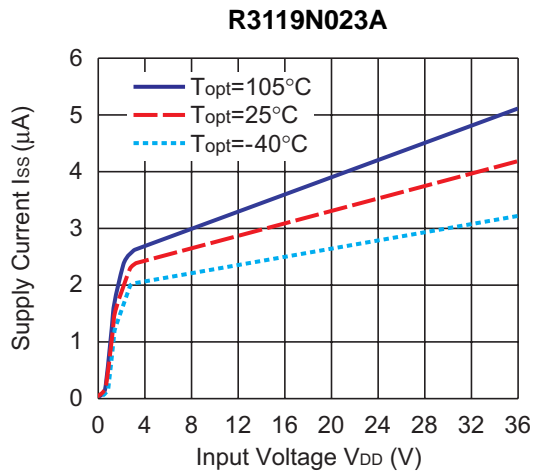
Nch Driver Output Current Test Circuit



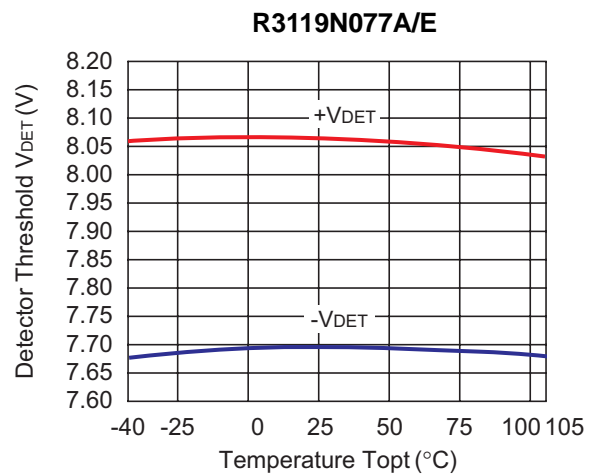
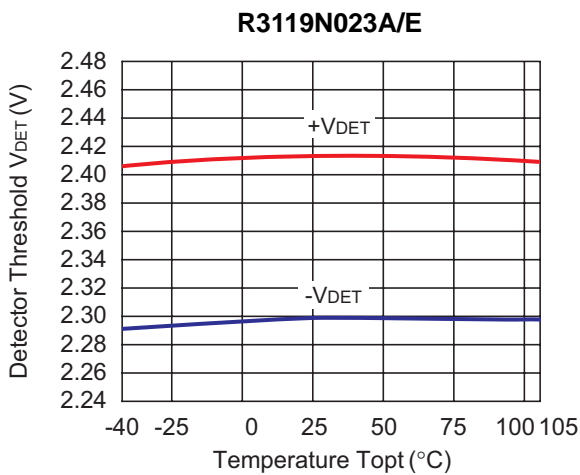
Output Delay Time Test Circuit

## TYPICAL CHARACTERISTICS

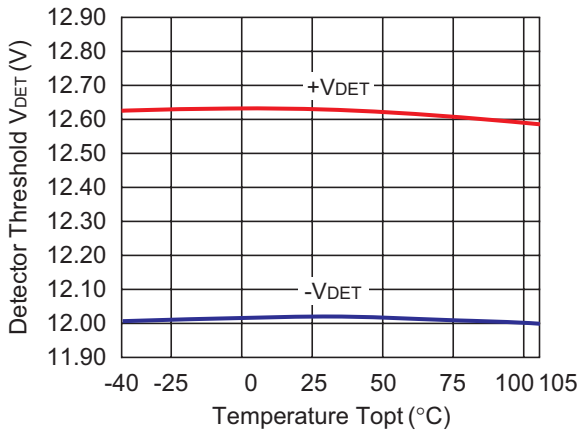
### 1) Supply Current vs. Input Voltage



### 2) Detector Threshold vs. Temperature

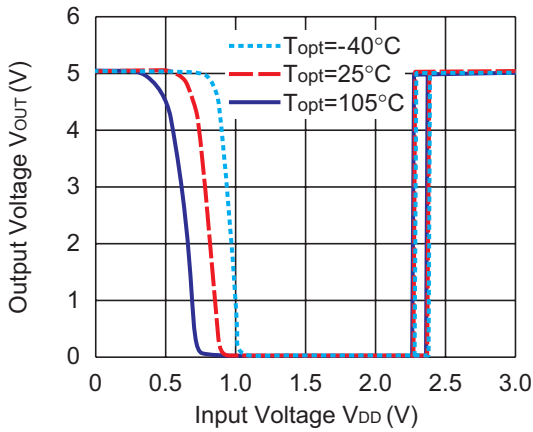


R3119N120A/E

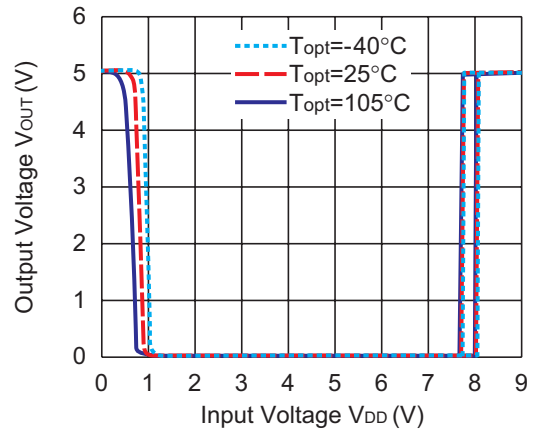


3) Output Voltage vs. Input Voltage

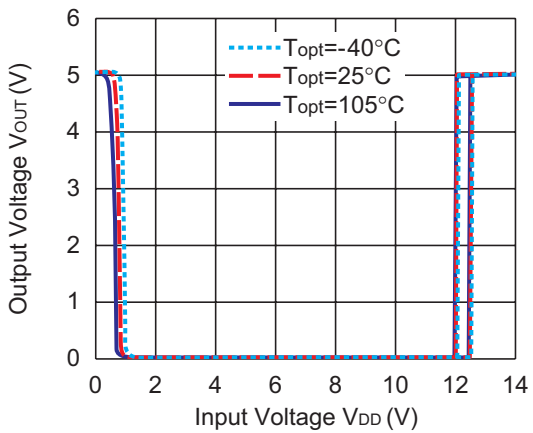
R3119N023A/E



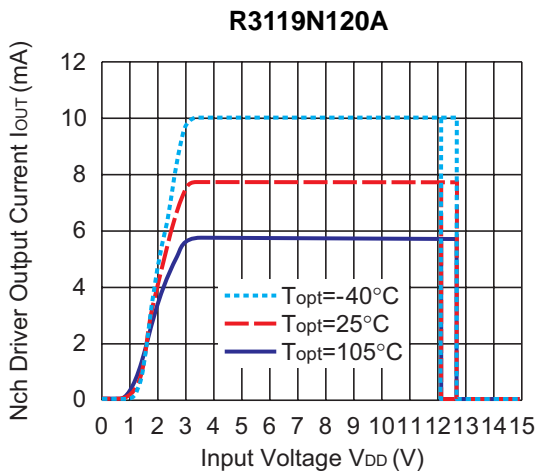
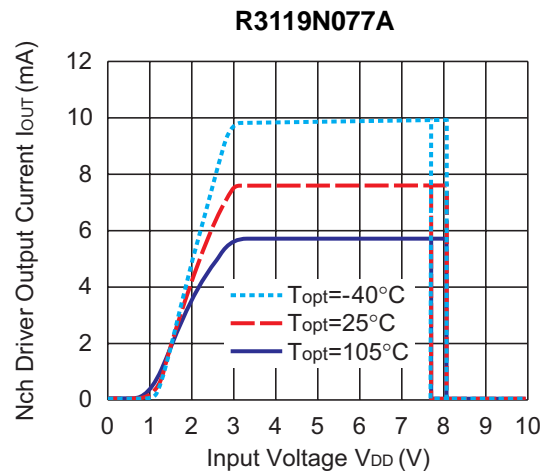
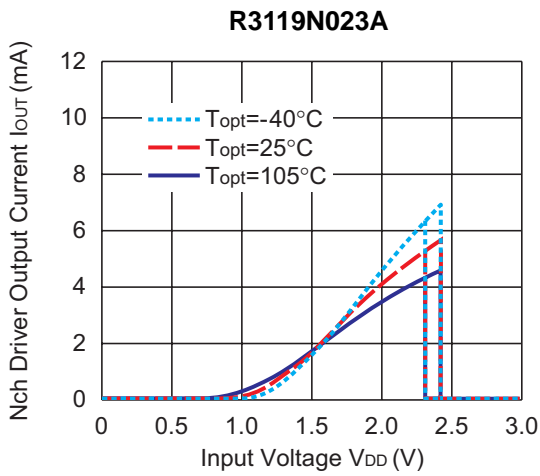
R3119N077A/E



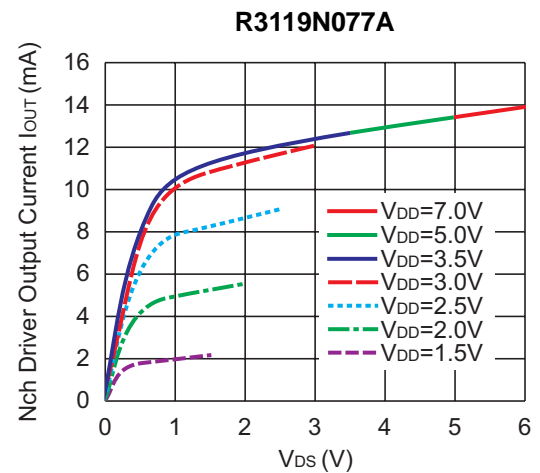
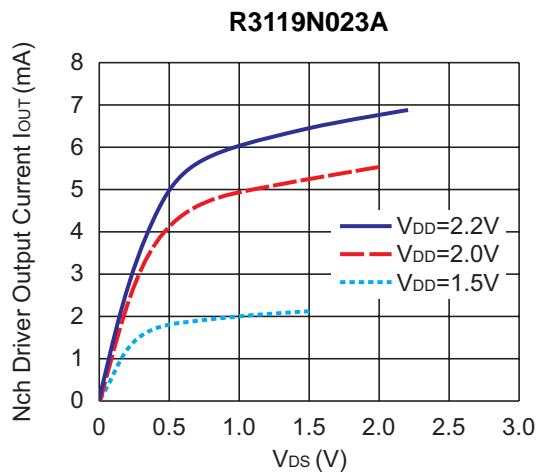
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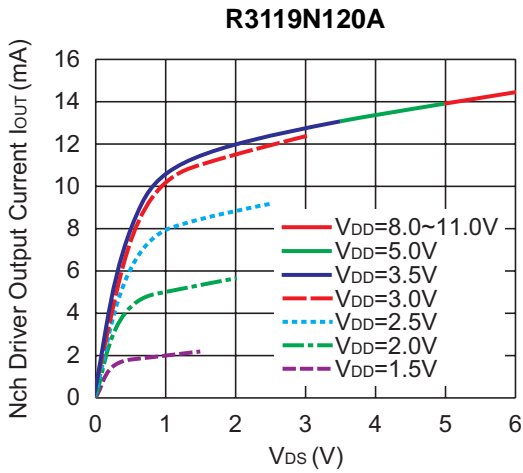


4) Nch Driver Output Current vs. Input Voltage

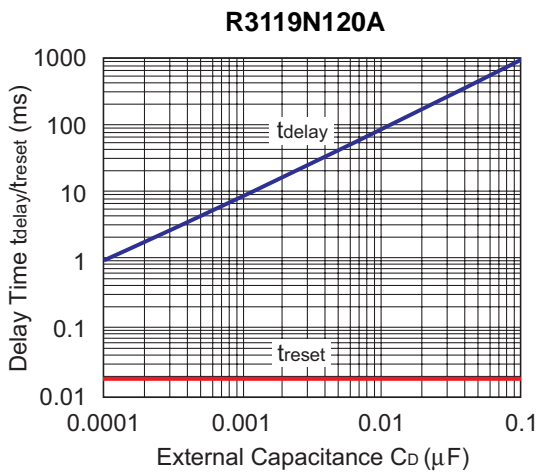
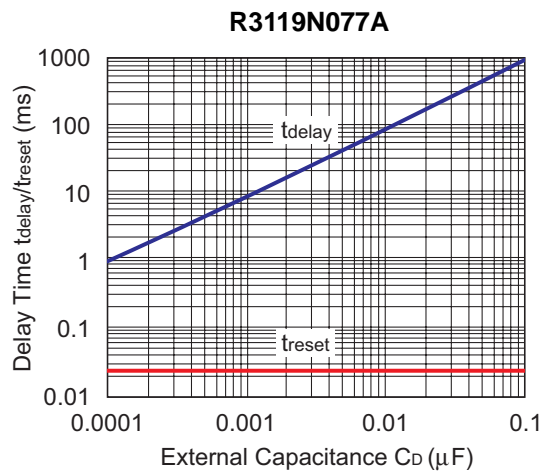
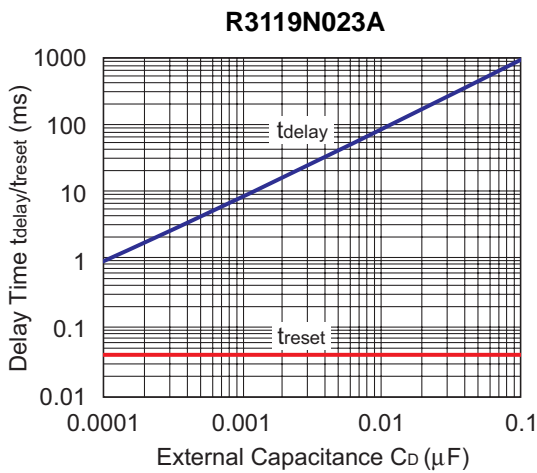


5) Nch Driver Output Current vs.  $V_{DS}$

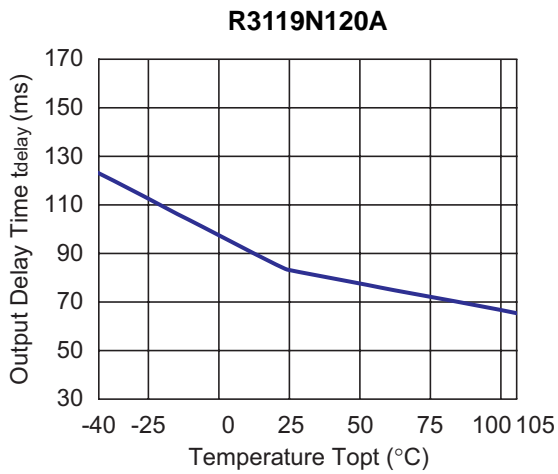
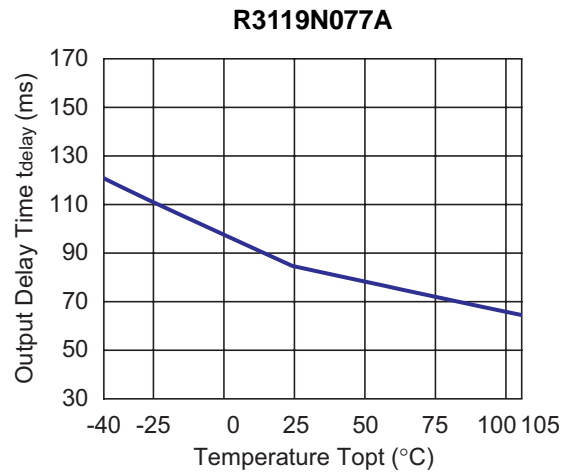
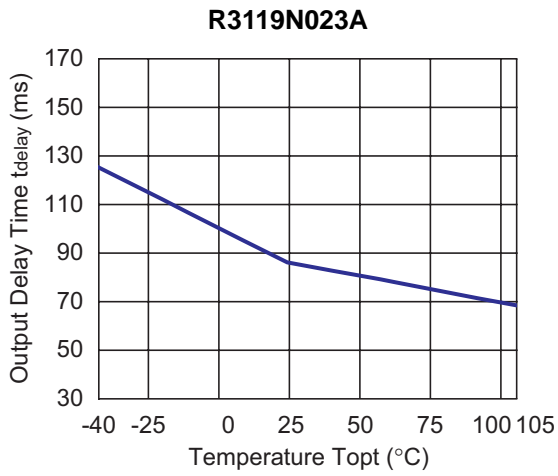




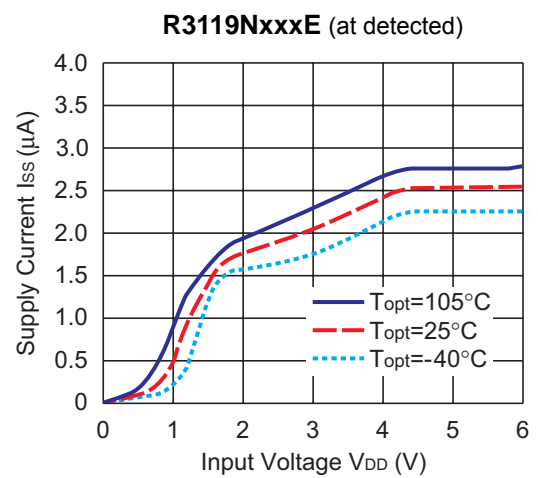
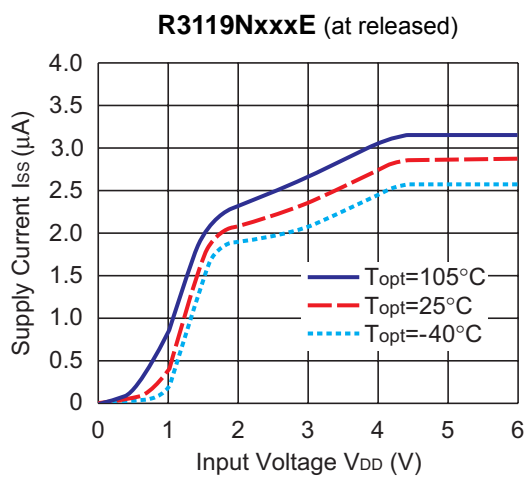
**6) Output Delay Time vs. External Capacitance ( $T_{opt}=25^{\circ}C$ )**



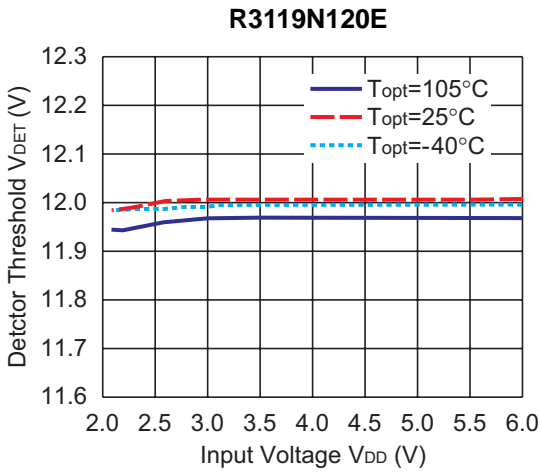
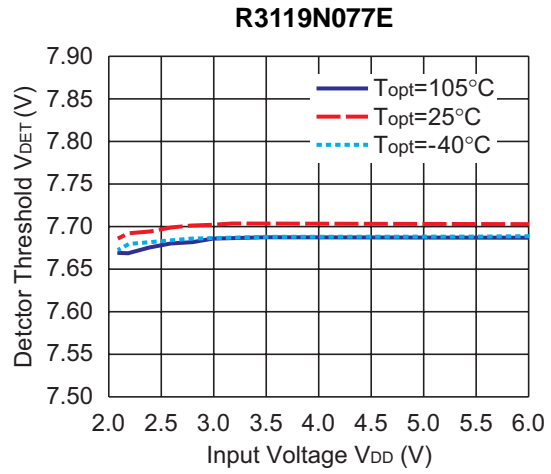
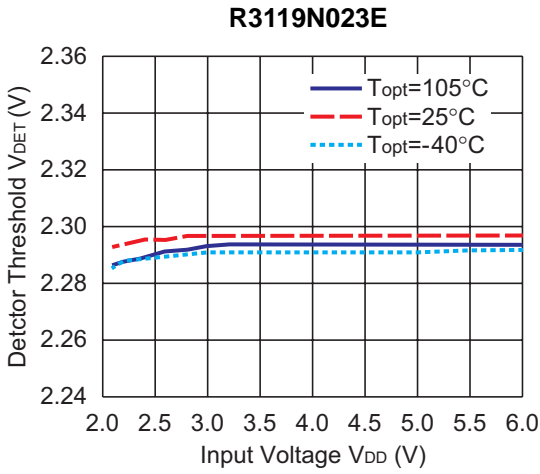
7) Output Delay Time vs. Temperature ( $C_D=0.01\mu F$ )



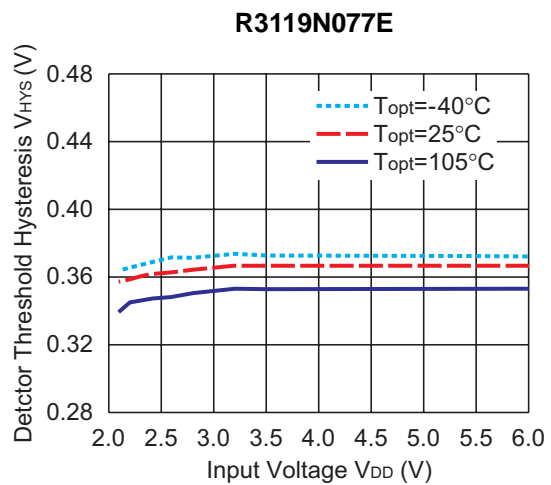
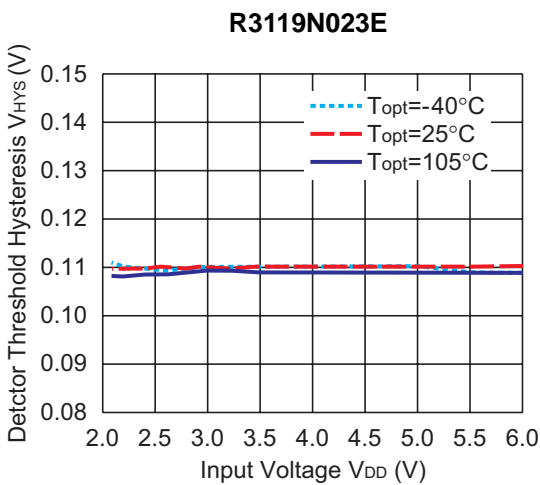
8) Supply Current vs. Input Voltage



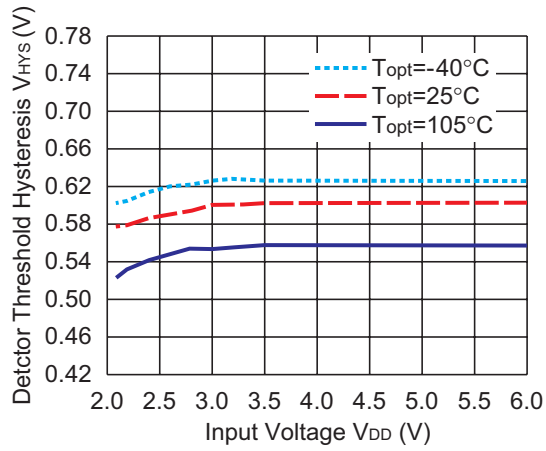
9) Detector Threshold vs. Input Voltage



10) Detector Threshold Hysteresis vs. Input Voltage

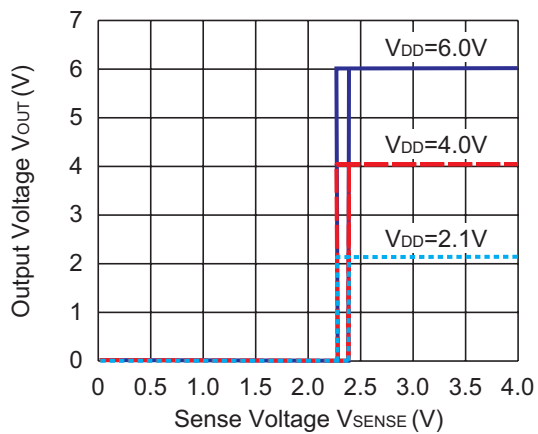


R3119N120E

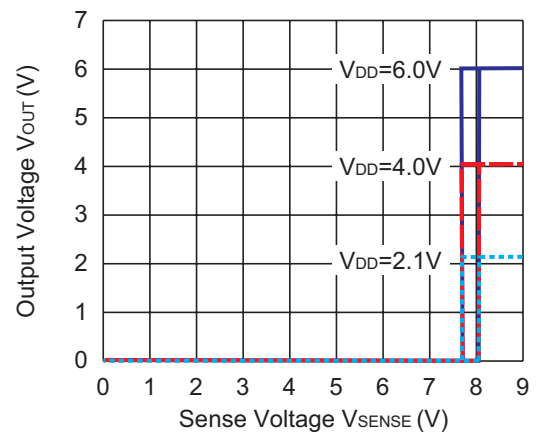


11) Output Voltage vs. SENSE pin Input Voltage ( $T_{opt} = 25^{\circ}\text{C}$ ) ( $D_{OUT}$  pull up to  $V_{DD}$  with  $100\text{k}\Omega$ )

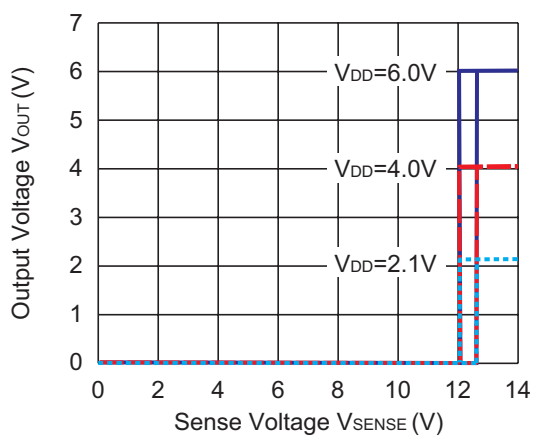
R3119N023E



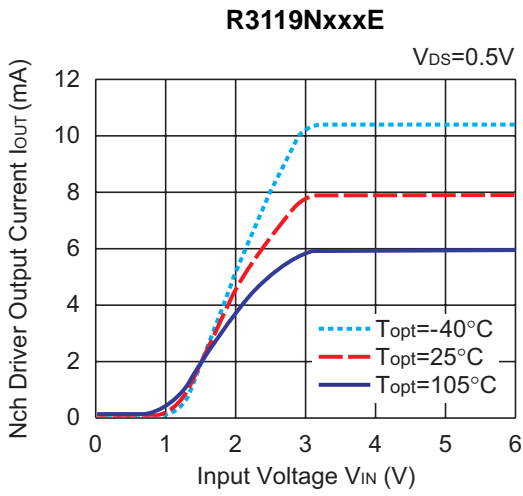
R3119N077E



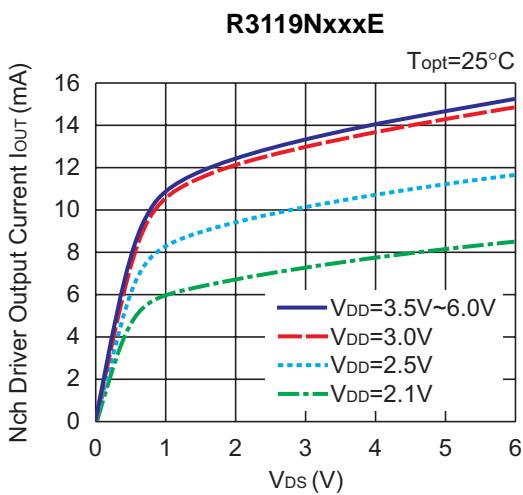
R3119N120E



12) Nch Driver Output Current vs. Input Voltage



13) Nch Driver Output Current vs.  $V_{DS}$



## TECHNICAL NOTES

When R3119NxxxA/E is used in Fig.A, Fig.B, if the value of R1 is set excessively large, the dropdown voltage caused by the consumption current of IC itself, may vary the detector threshold and the release voltage. Also, if the value of R1 is set excessively large, there may be delay in start-up and may cause oscillation generated by cross conduction current.

When R3119NxxxA is used in Fig.C, if the value of R1 is set excessively large, the dropdown voltage caused by the consumption current of IC itself, may vary the detector threshold and the released voltage. Also, if the value of R1 and R2 is set excessively large, there may be delay in start-up and may cause oscillation generated by cross conduction current.

When R3119NxxxA/E is used in Fig.D, Fig.E, if the value of R1 is set excessively large, the dropdown voltage caused by the consumption current of IC itself may vary the detector threshold and the release voltage. Also, if the value of R1 is set excessively large, there may be delay in start-up and may cause oscillation generated by cross conduction current. Furthermore, if the value of R1 is set large and the value of R3 is set small, released voltage level may shift and the minimum operating voltage may differ. If the value of R3 is set excessively small from R1, release may not occur and may cause oscillation.

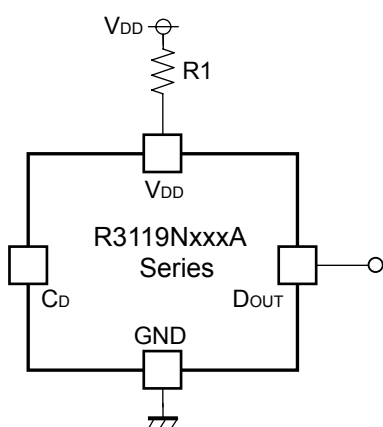


Fig.A

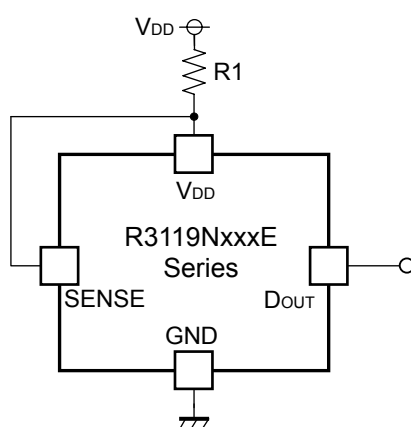


Fig.B

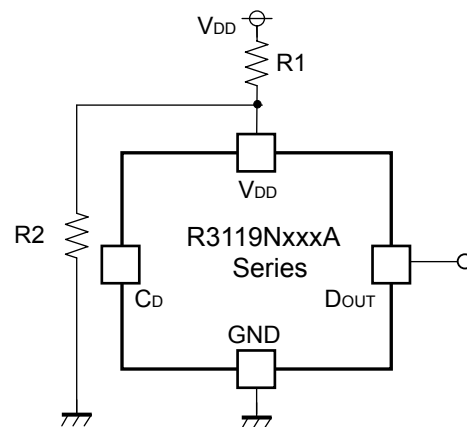


Fig.C

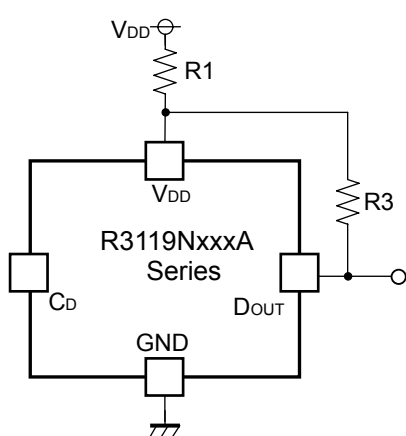


Fig.D

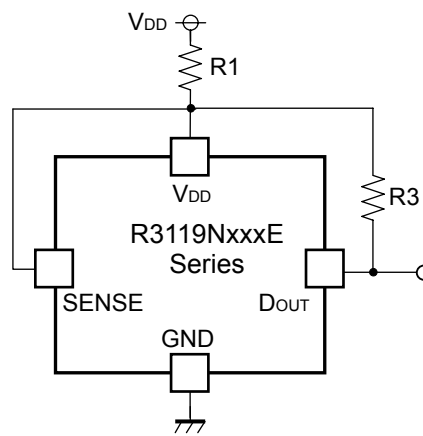


Fig.E



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Ricoh continually strives to promote customer satisfaction, and shares the achievements of its management quality improvement program with people and society.



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