50V INPUT VOLTAGE TYPE VOLTAGE DETECTOR

NO.EA-187-090115

OUTLINE

R3119N Series are CMOS process based (advantageous for low supply current) input voltage range (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 CD pin of external IC for setting the release-delay-time. R3119NxxxE has the SENSE pin of external IC.

The supply current of IC is only 3.3μA. The detector threshold is possible to set range from 2.3V to 12V internally with high accuracy (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

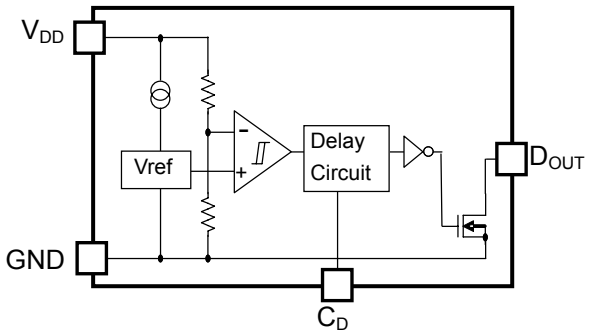
- Supply Current····· Typ.3.3μA
- Operating Voltage····· 1.5V~36.0V(C_D pin type: R3119NxxxA)
  2.1V~6.0V(SENSE pin type: R3119NxxxE)
- High Detect Voltage Accuracy ····· ±1.5% (Ta=25°C)
- Detect Voltage Range····· Stepwise setting with a step of 0.1V in the range of 2.3V to 12.0V is possible
- Released Delay Time (Power ON Reset Delay Time)···· -50~+80%(C_D pin type: R3119NxxxA)
- Package····· SOT-23-5

APPLICATIONS

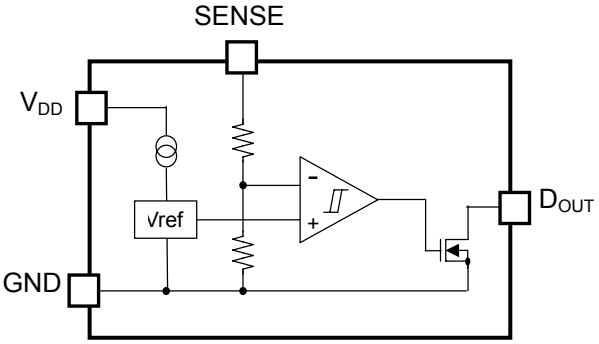
- CPU and logic circuit reset.
- Battery checker.
- Battery back-up circuit.
- Supervising of the power supply voltage of in-vehicle equipment.

BLOCK DIAGRAMS

R3119NxxxA



R3119NxxxE



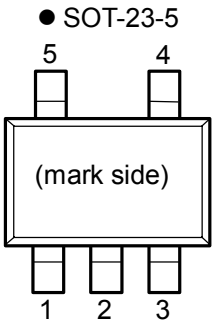
SELECTION GUIDE

The detect voltage, version, package, and the taping type for the ICs can be selected at the user's request. The selection can be made with designating the part number as shown below;

R3119x xxx x-xx-x ←Part Number
↑ ↑ ↑ ↑ ↑
a b c d e

Code	Contents
a	Designation of Package Type: N: SOT-23-5
b	Setting Detect Voltage: Stepwise setting with 0.1V in the range from 2.30V to 12.0V is possible
c	Designation of Active Type: A: with C_D pin type E: with SENSE pin type
d	Designation of Taping Type: Ex.TR (refer to Taping Specifications: TR type is the standard direction)
e	Designation of composition of pin plating: -F: Lead free solder plating

PIN CONFIGURATION



PIN DESCRIPTIONS

R3119N: SOT-23-5

Pin No.	Symbol	Description
1	V_{DD}	Input Pin
2	GND *	Ground Pin
3	GND *	Ground Pin
4	D_{OUT}	VD Output Pin
5	C_D	Connecting pin with external capacitor for setting delay time
	SENSE	Voltage Detector SENSE pin

* No. 2 and No.3 pin must be wired to the GND plan when it is mounted on board.

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Ratings		Unit
V_{DD}	Input Voltage	R3119NxxxA	-0.3~50.0	V
		R3119NxxxE	-0.3~7.0	
D_{OUT}	Output Voltage (D_{OUT} pin)	-0.3~7.0		V
V_{CD}	Output Voltage (C_D pin)	R3119NxxxA	-0.3~7.0	V
V_{SENSE}	Input Voltage (SENSE Pin)	R3119NxxxE	-0.3~50.0	V
I_{OUT}	Output Current (D_{OUT} pin)	20		mA
P_D	Power Dissipation*	SOT-23-5	420	mW
Ta	Ambient Temperature Range	- 40 ~ + 105		°C
Tstg	Storage Temperature Range	- 55 ~ + 125		°C

* For Power Dissipation, please refer to PACKAGE INFORMATION to be described

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_D pin type)

[ ] value indicate -40°C ≦ Ta ≦ 105°C is checked and guaranteed by design engineering.

Ta=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
I_{SS}	Supply Current	V_{DD}=(-V_{DET}) – 0.1V			3.3	[5.6]	μA
		V_{DD}=(-V_{DET}) + 1.0V			3.3	[5.5]	
-V_{DET}	Detector Threshold	V_{DD} pin	Ta=25°C	x 0.985		x 1.015	V
			-40°C ≦ Ta ≦ 105°C	[x 0.970]		[x 1.020]	
V_{HYS}	Detector Threshold Hysterisis			[3.5]	5	[6.5]	%
t_{DELAY}	Output Delay Time	V_{DD}=1.5V→(Vset)+2.0V C_D=0.01μF		[45]	85	[150]	ms
Δ-V_{DET} /ΔTa	Detector Threshold Temperature Coefficient	-40°C ≦ Ta ≦ 105°C			[±100]		ppm /°C
V_{DDH}	Maximum Operating Voltage					36	V
V_{DDL}	Minimum Operating Voltage *1	Ta=25°C				1.2	V
		-40°C ≦ Ta ≦ 105°C				[1.25]	
I_{OUT}	Output Current	V_{DD}=1.5V,V_{DS}=0.05V		[230]			μA
		2.3V ≦ (-V_{DET})<2.6V V_{DD}=2.2V V_{DS}=0.5V		[2.8]			mA
		2.6V ≦ (-V_{DET})<3.0V V_{DD} =2.5V V_{DS}=0.5V		[3.3]			
		3.0V ≦ (-V_{DET}) V_{DD} =2.9V V_{DS}=0.5V		[3.5]			

The specification in [ ] is checked and guaranteed by design engineering.

All of unit are tested and specified under load conditions such that Tj ≈ Ta=25°C except for Detector Threshold Temperature Coefficient item.

*1) 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.

R3119NxxxE (SENSE pin type)

[ ] value indicate -40°C ≦ Ta ≦ 105°C is checked and guaranteed by design engineering.

(Ta=25°C)

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{DD}	Input Voltage			[2.1]		[6.0]	V
I_{SS}	Supply Current	V_{DD}=6.0V SENSE=($-V_{DET}$) - 1.0V			3.3	[5.5]	μA
		V_{DD}=6.0V SENSE=($-V_{DET}$) + 1.0V			3.3	[5.5]	
$-V_{DET}$	Detector Threshold	SENSE pin V_{DD}=6.0V	Ta=25°C	x 0.985		x 1.015	V
			-40°C ≦ Ta ≦ 105°C	[x 0.970]		[x 1.020]	
V_{HYS}	Detector Threshold Hysterisis	V_{DD}=6.0V		[3.5]	5	[6.5]	%
t_{PLH}	Output Delay Time	V_{DD}=6.0V SENSE=1.5V→(Vset)+2.0V			15		μs
$\Delta-V_{DET}$ /ΔTa	Detector Threshold Temperature Coefficient	-40°C ≦ Ta ≦ 105°C			[±100]		ppm /°C
V_{DDH}	Maximum Operating Voltage					36	V
V_{DDL}	Minimum Operating Voltage *1	Ta=25°C				1.2	V
		-40°C ≦ Ta ≦ 105°C				[1.25]	
I_{OUT}	Output Current	SENSE < ($-V_{DET}$) V_{DD}=2.1V V_{DS}=0.05V		[420]			μA
		SENSE < ($-V_{DET}$) V_{DD}=2.2V V_{DS}=0.5V		[2.8]			mA

The specification in [ ] is checked and guaranteed by design engineering.

All of unit are tested and specified under load conditions such that Tj ≈ Ta=25°C except for Detector Threshold Temperature Coefficient and Output Delay Time item.

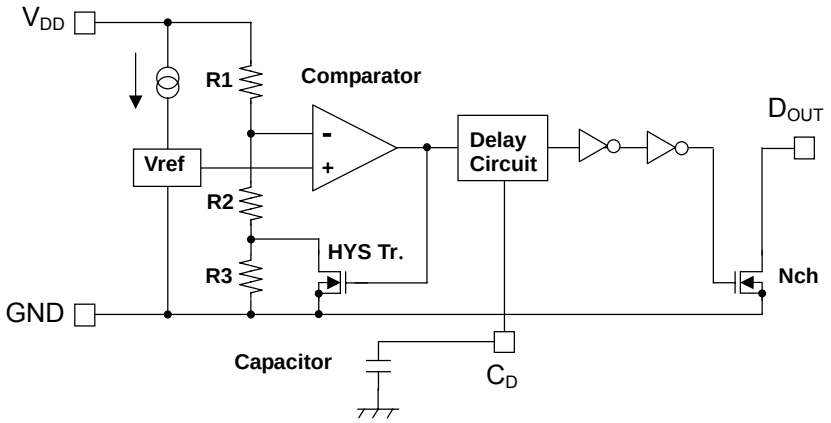
*1) This value is the minimum input voltage when the output voltage is 0.1V or less at detection. (the pull-up resistance;100kΩ, the pull-up voltage;5.0V)

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.

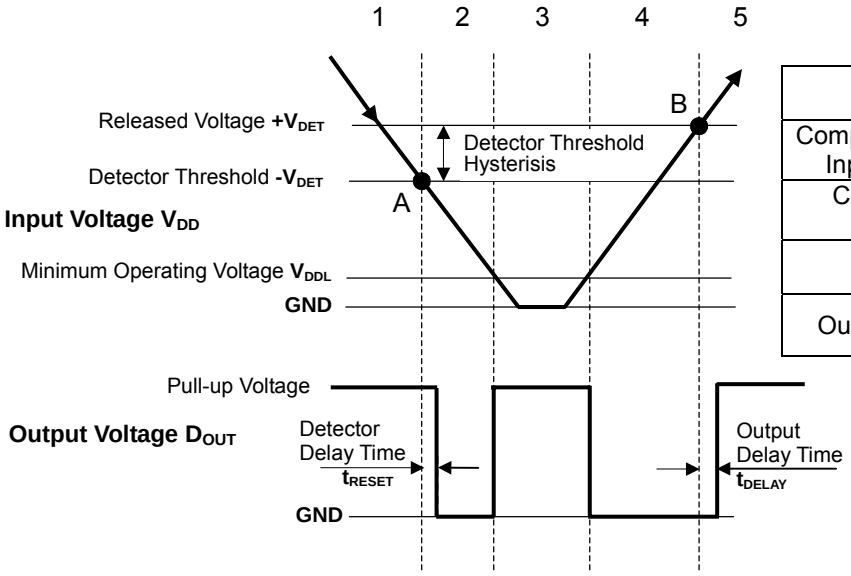
OPERATING

● Diagram for Operation (C_D pin type: R3119NxxxA)



▪Due to Nch Open Drain output, D_{OUT} pin should be pulled-up to an external voltage level.

Fig.1 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
HYS Tr.	OFF	ON	Indefinite	ON	OFF
Output Nch Tr.	OFF	ON	Indefinite	ON	OFF

Fig.2 Operation Diagram

$$I \quad \frac{R2+R3}{R1+R2+R3} \times V_{DD}$$

$$II \quad \frac{R2}{R1+R2} \times V_{DD}$$

● Explanation of Operation

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

Step 2. At point “A”, Vref $\geq V_{DD}$ x (R2+R3) / (R1+R2+R3) 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 input 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.

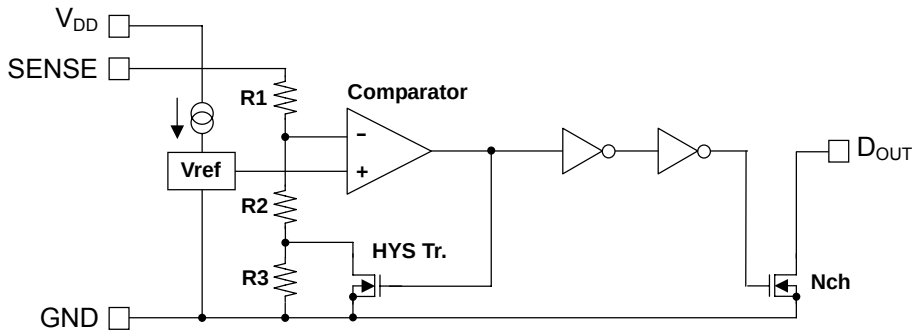
Step 4. The output voltage is equal to the GND level.

Step 5. At Point “B”, Vref $\leq V_{DD}$ x R2 / (R1+R2) it 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 ($+V_{DET}$)

Output delay time (t_{DELAY}) is calculatable by an external capacitor as the following formula.

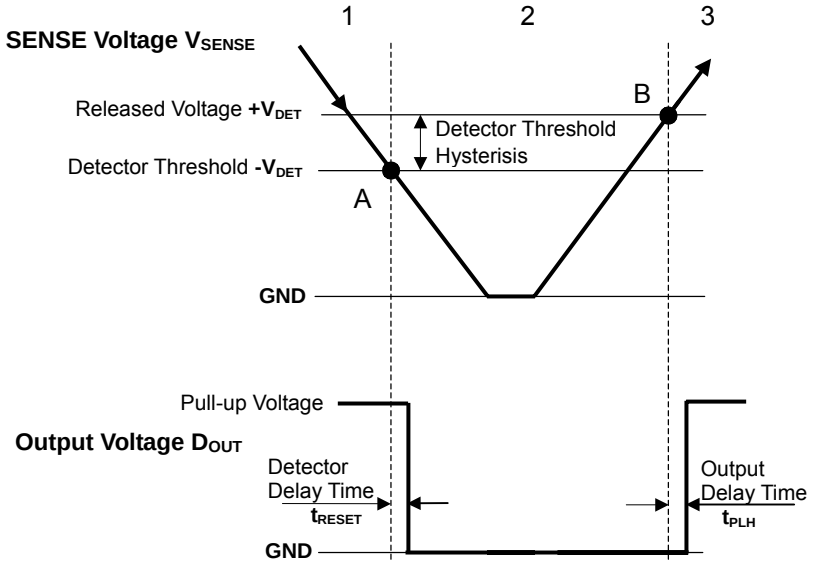
t_{DELAY} [s] =8.5 x 10^6 x C_D [F]

● Diagram for Operation (SENSE pin type: R3119NxxxE)



▪Due to Nch Open Drain output, D_{OUT} pin should be pulled-up to an external voltage level.

Fig.3 Block Diagram



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

Fig.4 Operation Diagram

$$\text{I} \quad \frac{R2+R3}{R1+R2+R3} \times V_{SENSE}$$

$$\text{II} \quad \frac{R2}{R1+R2} \times V_{SENSE}$$

● Explanation of Operation

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

Step 2. At Point “A”, Vref $\geq V_{SENSE}$ x (R2+R3) / (R1+R2+R3) is true, as a result, the output of comparator is reversed from “L” to “H”, then the output voltage is equal to the pull-up voltage. The voltage level of Point A means a detector threshold voltage ($-V_{DET}$)

Step 3. At Point “B”, Vref $\leq V_{SENSE}$ x R2 / (R1+R2) 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 ($+V_{DET}$)

● Power Supply Injection Order

The R3119NxxxE Series (SENSE pin type) 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.5). Besides, a voltage beyond V_{DD} pin is also acceptable to SENSE pin.

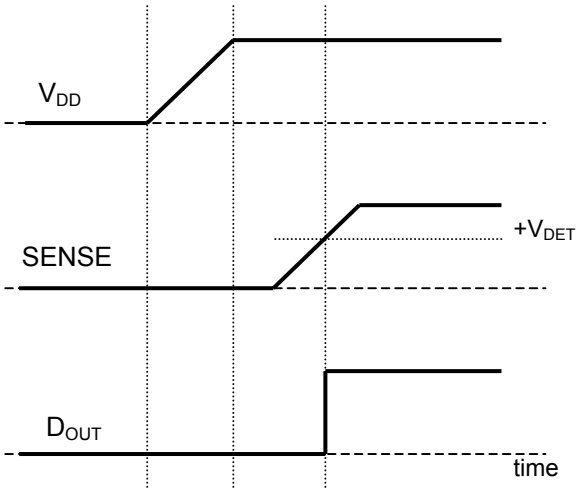
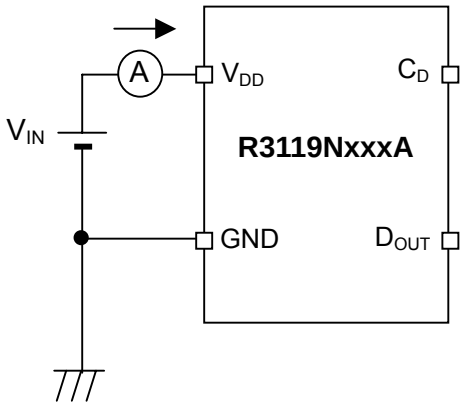


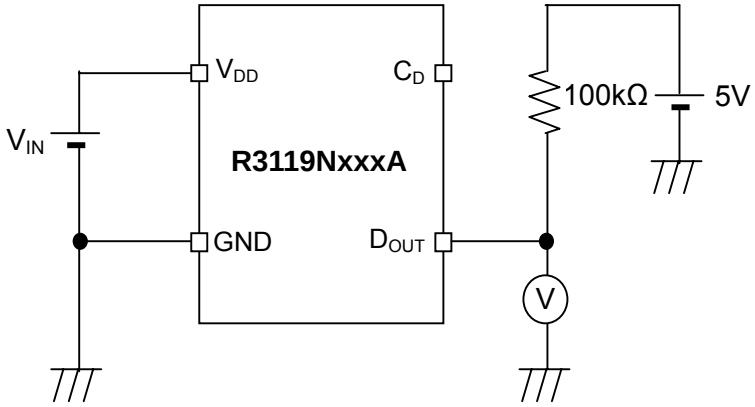
Fig.5 Turn On Sequence

TEST CIRCUITS

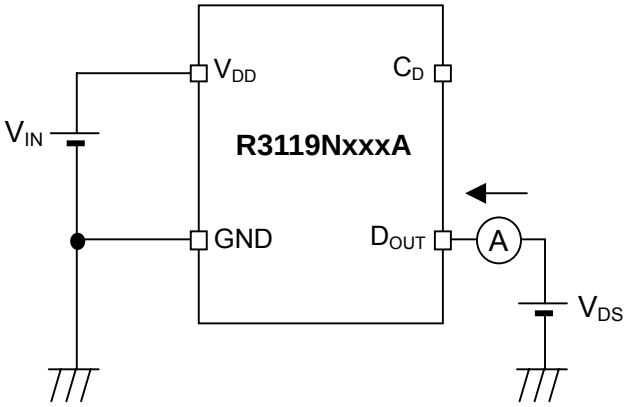
- R3119NxxxA (C_D pin type)



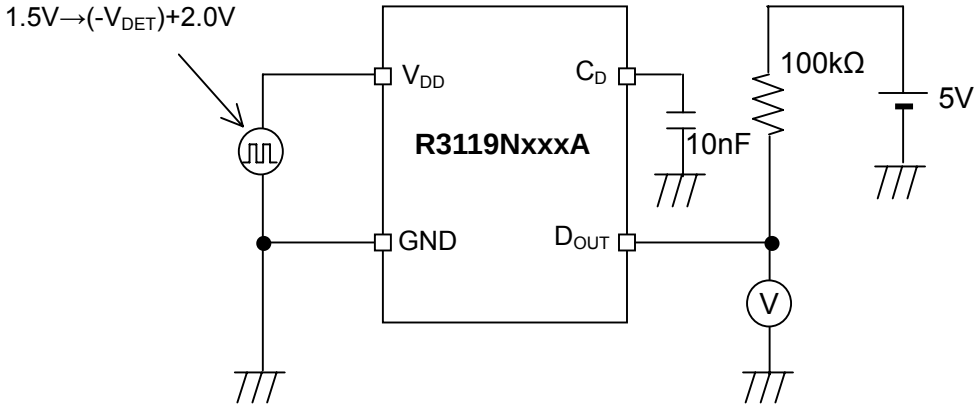
Test Circuit for Supply Current



Test Circuit for Detector Threshold

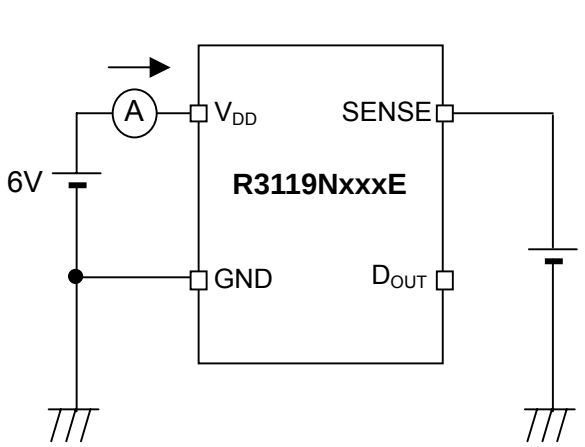


Test Circuit for Nch Driver Output Current

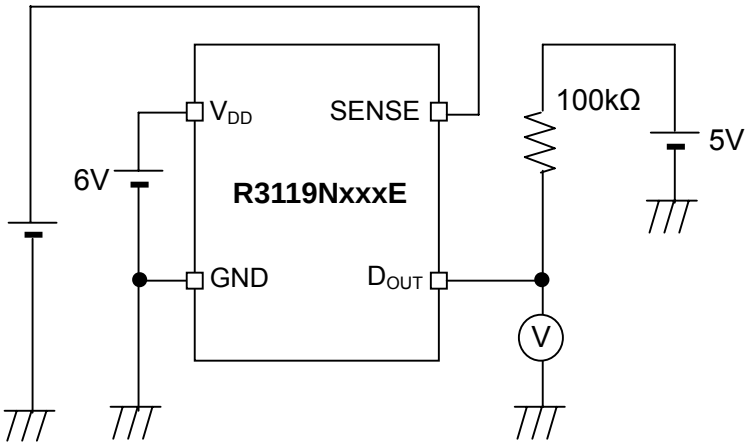


Test Circuit for Output Delay Time

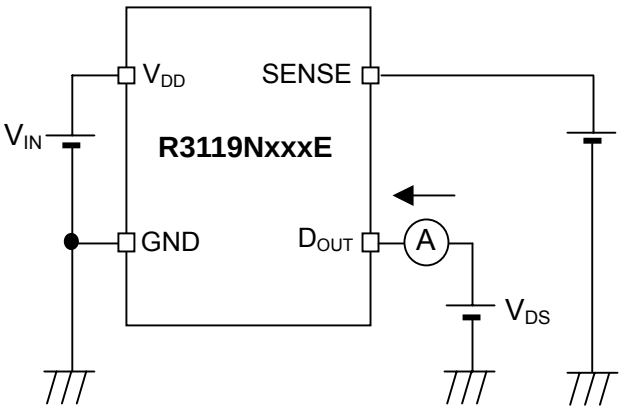
- R3119NxxxE (SENSE pin type)



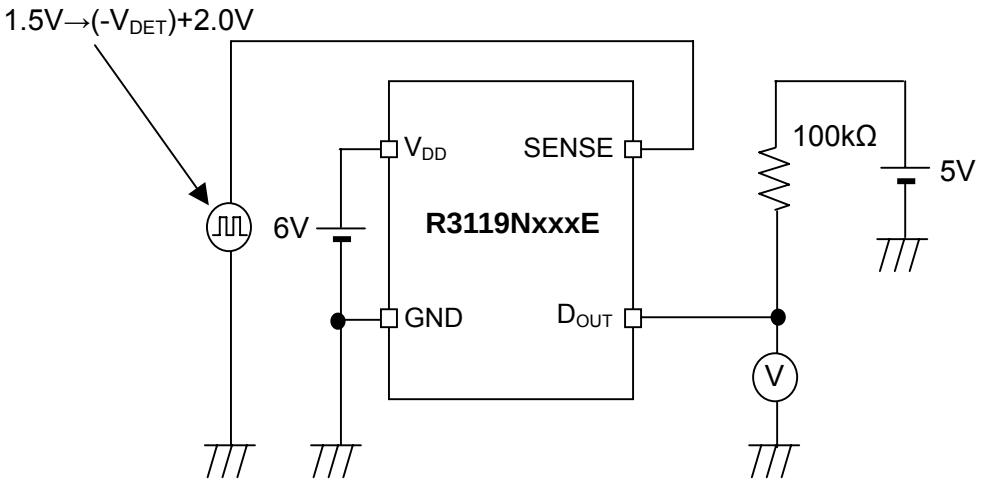
Test Circuit for Supply Current



Test Circuit for Detector Threshold



Test Circuit for Nch Driver Output Current



Test Circuit for Output Delay Time

TECHNICAL NOTES

When R3119NxxxA/E is used in Fig.A, Fig.X, 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. 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 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.C, Fig.Y, 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.

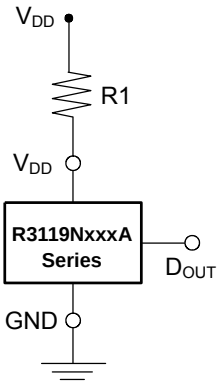


Fig.A

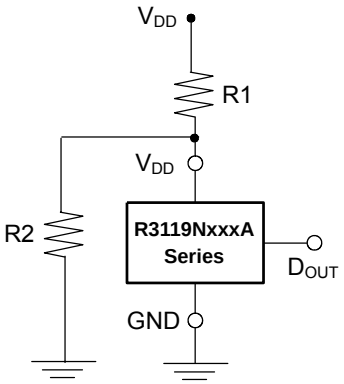


Fig.B

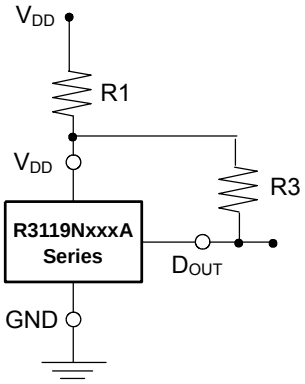


Fig.C

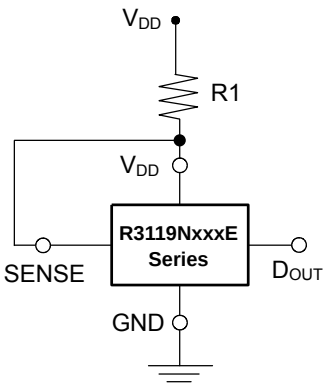


Fig.X

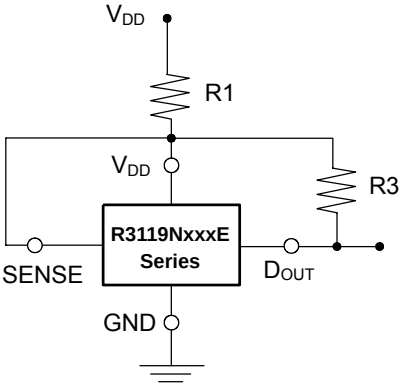


Fig.Y

POWER DISSIPATION (SOT-23-5)

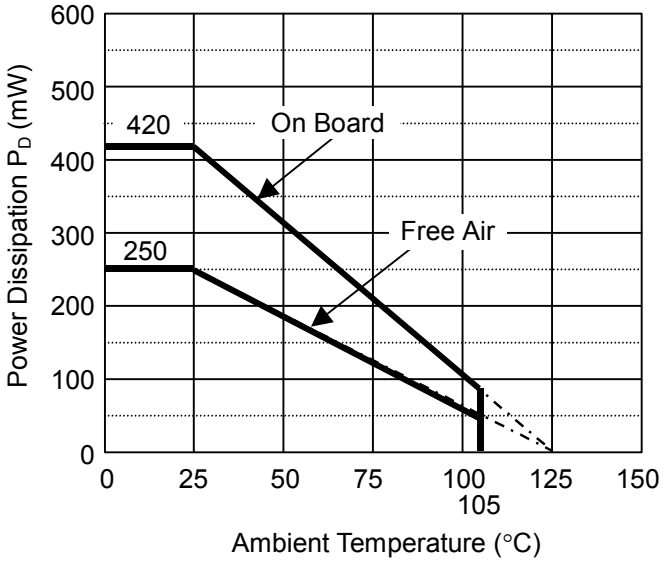
This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:
(Power Dissipation (SOT-23-5) is substitution of SOT-23-6.)

Measurement Conditions

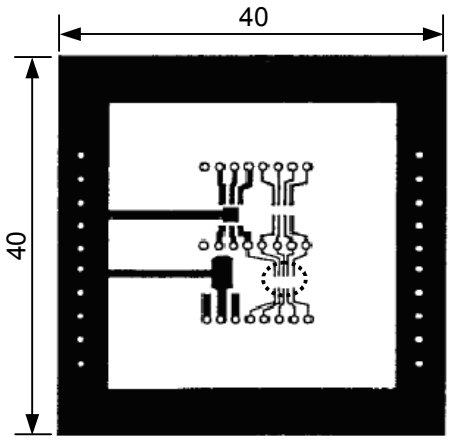
	Standard Test Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm * 40mm * 1.6mm
Copper Ratio	Top side: Approx. 50%, Back side: Approx. 50%
Through-holes	ϕ 0.5mm * 44pcs

Measurement Result (Ta=25°C, Tjmax=125°C)

	Standard Land Pattern	Free Air
Power Dissipation	420mW	250mW
Thermal Resistance	θja = (125-25°C)/0.42W= 263°C/W	400°C/W



Power Dissipation



Measurement Board Pattern

IC Mount Area (Unit: mm)