Low Voltage Detector with SENSE Pin for Automotive Applications

No. EC-261-200807

NOTICE

R3117Nxx3A/C may cause the malfunction (miss detection), in the case of its V_{DD} pin voltage changes very rapidly. Please see “Power Supply Injection Order” for details.

OUTLINE

The R3117Nxx3 is a CMOS-based voltage detector IC with high detector threshold accuracy and ultra-low supply current, which can be operated at an extremely low voltage and is used for system reset as an example.

The IC consists of a voltage reference unit, a comparator, resistors for detector threshold setting, an output driver and a hysteresis circuit. The detector threshold is fixed with high accuracy internally and does not require any adjustment.

The tolerance of the detector threshold is ±15mV ($-V_{DET} \leqq 1.5V$) or ±1.0% ($1.5V< -V_{DET}$). Since the sense pin is separated from the V_{DD} pin of the IC, therefore, even if the sense pin voltage becomes to 0V, the output voltage keeps its "L" level.

Two output types, Nch open drain type and CMOS type are available. The R3117Nxx3 supports the SOT-23-5 package.

FEATURES*

- Operating Voltage Range (Maximum Rating) .... 1.0V to 6.0V (7.0V)
- Supply Current .... Typ. 0.29μA (V_{DD}=6.0V)
  Not including the consumption current for SENSE pin.
- Detector Threshold Range .... 0.7V to 5.0V (0.1V steps)
- Accuracy Detector Threshold.. ±1.0% ($-V_{DET} \geqq 1.6V$), ±15mV ($-V_{DET}<1.6V$)
- Temperature-Drift Coefficient of Detector Threshold .... Typ. ±30ppm/°C
- Output Types.. Nch Open Drain and CMOS
- Packages SOT-23-5

∗ Ta=25°C, unless otherwise noted.

APPLICATIONS

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

SELECTION GUIDE

The package type, the detector threshold, the output type and the taping type for the IC can be selected at the users' request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R3117Nxx3∗-TR-#E	SOT-23-5	3,000 pcs	Yes	Yes

xx: The detector threshold can be designated in the range from 0.7V(07) to 5.0V(50) in 0.1V steps.

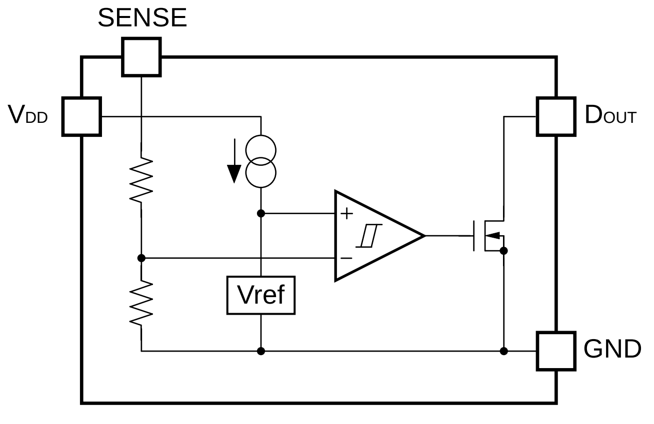
∗ : Designation of Output Type
(A) Nch Open Drain
(C) CMOS

: Quality Class

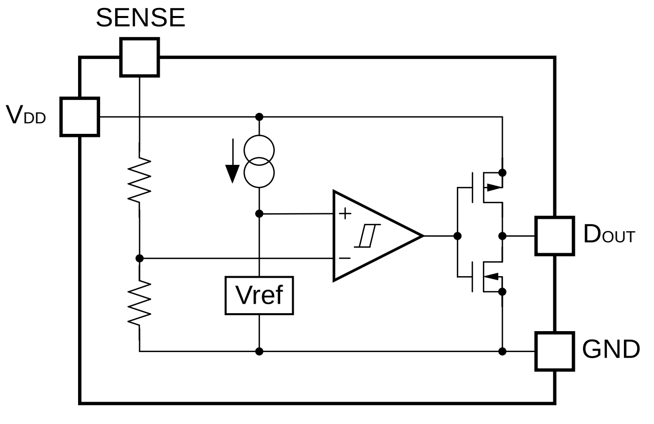
	Operating Temperature Range	Test Temperature	AEC-Q100
A	−40°C to 105°C	25°C, High	Grade 2

BLOCK DIAGRAMS

Nch Open Drain Output (R3117Nxx3A)

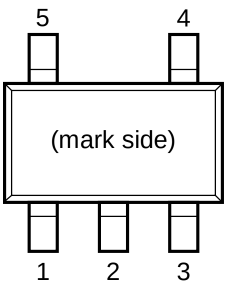


CMOS Output (R3117Nxx3C)



PIN DESCRIPTIONS

- **SOT-23-5**



Pin No.	Symbol	Description
1	D_{OUT}	Output Pin ("L" at detection)
2	V_{DD}	Input Pin
3	GND	Ground Pin
4	NC	No Connection
5	SENSE	Voltage Detector Voltage Sense Pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item		Rating	Unit
V_{DD}	Supply Voltage		7.0	V
V_{SENSE}	SENSE Pin Voltage		7.0	V
V_{OUT}	Output Voltage (Nch Open Drain Output)		V_{SS}–0.3 to 7.0	V
	Output Voltage (CMOS Output)		V_{SS}–0.3 to V_{DD}+0.3	
I_{OUT}	Output Current		20	mA
P_D	Power Dissipation* (JEDEC STD. 51-7 Test Land Pattern)	SOT-23-5	660	mW
Tj	Junction Temperature Range		–40 to 125	°C
Tstg	Storage Temperature Range		–55 to 125	°C

* Please refer to *POWER DISSIPATION* for detailed 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 are not assured.

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Rating	Unit
V_{DD}	Supply Voltage	1.0 to 6.0	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

The specifications surrounded by ☐ are guaranteed by design engineering at -40°C ≤ Ta ≤ 105°C.

R3117Nxx3A/C

(Ta=25°C)

Symbol	Item	Conditions			Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold (Ta=25°C)	0.7V ≦ $-V_{DET}$<1.6V	1.0V ≦ V_{DD} ≦ 5.25V		$-V_{DET}$-15		$-V_{DET}$+15	mV
			5.25V < V_{DD} ≦ 6.0V		$-V_{DET}$-11		$-V_{DET}$+24	mV
		1.6V ≦ $-V_{DET}$ ≦ 5.0V	1.0V ≦ V_{DD} ≦ 5.25V		$-V_{DET}$ ×0.99		$-V_{DET}$ ×1.01	V
			5.25V < V_{DD} ≦ 6.0V		$-V_{DET}$ ×0.9925		$-V_{DET}$ ×1.016	V
$-V_{DET}$	Detector Threshold (-40°C ≦ Ta ≦ 105°C)	0.7V ≦ $-V_{DET}$<1.6V	1.0V ≦ V_{DD} ≦ 5.25V		$-V_{DET}$-30		$-V_{DET}$+30	mV
			5.25V < V_{DD} ≦ 6.0V		$-V_{DET}$-26		$-V_{DET}$+39	mV
		1.6V ≦ $-V_{DET}$ ≦ 5.0V	1.0V ≦ V_{DD} ≦ 5.25V		$-V_{DET}$ ×0.98		$-V_{DET}$ ×1.02	V
			5.25V < V_{DD} ≦ 6.0V		$-V_{DET}$ ×0.9825		$-V_{DET}$ ×1.026	V
V_{HYS}	Detector Threshold Hysteresis	V_{DD}=1.0V to 6.0V			$-V_{DET}$ ×0.04		$-V_{DET}$ ×0.07	V
I_{SS}	Supply Current*1	V_{SENSE}=$-V_{DET}$-0.1V				0.31	1.47	µA
		V_{SENSE}=$-V_{DET}$×1.1				0.29	1.25	µA
R_{SENSE}	Sense Resistor	$-V_{DET}$ < 1.5V			6	25		MΩ
		1.5V ≦ $-V_{DET}$ < 4.7V			5	40		MΩ
		4.7V ≦ $-V_{DET}$			10	40		MΩ
V_{DDL}	Minimum Operating Voltage*2	Ta=25°C					0.50	V
		-40°C ≦ Ta ≦ 105°C					0.55	V
I_{OUT}	Output Current (Driver Output Pin)	Nch	V_{DD}=0.6V, V_{DS}=0.05V		7			µA
		Nch	$-V_{DET}$ < 1.1V	V_{DD}=0.6V V_{DS}=0.5V	0.020			mA
		Nch	1.1V ≦ $-V_{DET}$ < 1.6V	V_{DD}=1.0V V_{DS}=0.5V	0.400			mA
		Nch	1.6V ≦ $-V_{DET}$ < 3.1V	V_{DD}=1.5V V_{DS}=0.5V	1.000			mA
		Nch	3.1V ≦ $-V_{DET}$	V_{DD}=3.0V V_{DS}=0.5V	2.400			mA
		Pch*3	$-V_{DET}$ < 4.0V	V_{DD}=4.5V V_{DS}=2.1V	0.650			mA
		Pch*3	4.0V ≦ $-V_{DET}$	V_{DD}=6.0V V_{DS}=2.1V	0.900			mA
I_{LEAK}	Nch Driver Leakage Current*4	V_{DD}=6.0V, V_{DS}=7.0V					140	nA
t_{PHL}	Detector Output Delay Time*5	V_{DD}=5V	$-V_{DET}$ < 1.5V			80		µs
			1.5V ≦ $-V_{DET}$			40		µs
t_{PLH}	Release Output Delay Time*5	V_{DD}=5V	$-V_{DET}$ < 4.5V			50		µs
			4.5V ≦ $-V_{DET}$			100		µs

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

*1 Consumption current through SENSE pin is not included.

*2 In case that the V_{DD} pin and SENSE pin are connected and the value shows the minimum supply voltage (V_{DD}) when the output voltage at detector threshold can be maintained as 0.1V or less. (In case of Nch open drain type, pull-up resistor is 470kΩ and pull-up voltage is set at 5V for testing.) If V_{DD} is high enough, down to 0V is acceptable for SENSE pin.

*3 In case of CMOS type

*4 In case of Nch Open Drain type

*5 In the case of CMOS output type:

Time interval from forcing pulsive 6.0V to $-V_{DET}$-2.0V or 0V, or from forcing 0V to $-V_{DET}$+2.0V or 6.0V to SENSE pin, to when the output voltage will reach V_{DD}/2.

In the case of Nch Open drain output type:

Output pin is pulled up to 5V with 470kΩ and time interval from forcing 6.0V to $-V_{DET}$-2.0V or 0V, or forcing pulsive 0V to $-V_{DET}$+2.0V or 6.0V to when the output voltage reaches up to 2.5V.

Electrical Characteristics by Detector Threshold

Bold values are checked and guaranteed by design engineering at −40°C ≦ Ta ≦ 105°C, unless otherwise noted.

R3117N073A/C to R3117N503A/C (Ta=25°C)

Part Number	Detector Threshold 1.0V ≦ VDD ≦ 5.25V		Detector Threshold 1.0V ≦ VDD ≦ 5.25V		Detector Threshold 5.25V < VDD ≦ 6.0V		Detector Threshold 5.25V < VDD ≦ 6.0V		Detector Threshold Hysteresis	
	-VDET [V]		-VDET [V]		-VDET [V]		-VDET [V]		VHYS [V]	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
R3117N073A/C	0.6850	0.7150	**0.6700**	**0.7300**	0.6890	0.7240	**0.6740**	**0.7390**	**0.028**	**0.049**
R3117N083A/C	0.7850	0.8150	**0.7700**	**0.8300**	0.7890	0.8240	**0.7740**	**0.8390**	**0.032**	**0.056**
R3117N093A/C	0.8850	0.9150	**0.8700**	**0.9300**	0.8890	0.9240	**0.8740**	**0.9390**	**0.036**	**0.063**
R3117N103A/C	0.9850	1.0150	**0.9700**	**1.0300**	0.9890	1.0240	**0.9740**	**1.0390**	**0.040**	**0.070**
R3117N113A/C	1.0850	1.1150	**1.0700**	**1.1300**	1.0890	1.1240	**1.0740**	**1.1390**	**0.044**	**0.077**
R3117N123A/C	1.1850	1.2150	**1.1700**	**1.2300**	1.1890	1.2240	**1.1740**	**1.2390**	**0.048**	**0.084**
R3117N133A/C	1.2850	1.3150	**1.2700**	**1.3300**	1.2890	1.3240	**1.2740**	**1.3390**	**0.052**	**0.091**
R3117N143A/C	1.3850	1.4150	**1.3700**	**1.4300**	1.3890	1.4240	**1.3740**	**1.4390**	**0.056**	**0.098**
R3117N153A/C	1.4850	1.5150	**1.4700**	**1.5300**	1.4890	1.5240	**1.4740**	**1.5390**	**0.060**	**0.105**
R3117N163A/C	1.5840	1.6160	**1.5680**	**1.6320**	1.5880	1.6256	**1.5720**	**1.6416**	**0.064**	**0.112**
R3117N173A/C	1.6830	1.7170	**1.6660**	**1.7340**	1.6872	1.7272	**1.6702**	**1.7442**	**0.068**	**0.119**
R3117N183A/C	1.7820	1.8180	**1.7640**	**1.8360**	1.7865	1.8288	**1.7685**	**1.8468**	**0.072**	**0.126**
R3117N193A/C	1.8810	1.9190	**1.8620**	**1.9380**	1.8857	1.9304	**1.8667**	**1.9494**	**0.076**	**0.133**
R3117N203A/C	1.9800	2.0200	**1.9600**	**2.0400**	1.9850	2.0320	**1.9650**	**2.0520**	**0.080**	**0.140**
R3117N213A/C	2.0790	2.1210	**2.0580**	**2.1420**	2.0842	2.1336	**2.0632**	**2.1546**	**0.084**	**0.147**
R3117N223A/C	2.1780	2.2220	**2.1560**	**2.2440**	2.1835	2.2352	**2.1615**	**2.2572**	**0.088**	**0.154**
R3117N233A/C	2.2770	2.3230	**2.2540**	**2.3460**	2.2827	2.3368	**2.2597**	**2.3598**	**0.092**	**0.161**
R3117N243A/C	2.3760	2.4240	**2.3520**	**2.4480**	2.3820	2.4384	**2.3580**	**2.4624**	**0.096**	**0.168**
R3117N253A/C	2.4750	2.5250	**2.4500**	**2.5500**	2.4812	2.5400	**2.4562**	**2.5650**	**0.100**	**0.175**
R3117N263A/C	2.5740	2.6260	**2.5480**	**2.6520**	2.5805	2.6416	**2.5545**	**2.6676**	**0.104**	**0.182**
R3117N273A/C	2.6730	2.7270	**2.6460**	**2.7540**	2.6797	2.7432	**2.6527**	**2.7702**	**0.108**	**0.189**
R3117N283A/C	2.7720	2.8280	**2.7440**	**2.8560**	2.7790	2.8448	**2.7510**	**2.8728**	**0.112**	**0.196**
R3117N293A/C	2.8710	2.9290	**2.8420**	**2.9580**	2.8782	2.9464	**2.8492**	**2.9754**	**0.116**	**0.203**
R3117N303A/C	2.9700	3.0300	**2.9400**	**3.0600**	2.9775	3.0480	**2.9475**	**3.0780**	**0.120**	**0.210**
R3117N313A/C	3.0690	3.1310	**3.0380**	**3.1620**	3.0767	3.1496	**3.0457**	**3.1806**	**0.124**	**0.217**
R3117N323A/C	3.1680	3.2320	**3.1360**	**3.2640**	3.1760	3.2512	**3.1440**	**3.2832**	**0.128**	**0.224**
R3117N333A/C	3.2670	3.3330	**3.2340**	**3.3660**	3.2752	3.3528	**3.2422**	**3.3858**	**0.132**	**0.231**
R3117N343A/C	3.3660	3.4340	**3.3320**	**3.4680**	3.3745	3.4544	**3.3405**	**3.4884**	**0.136**	**0.238**
R3117N353A/C	3.4650	3.5350	**3.4300**	**3.5700**	3.4737	3.5560	**3.4387**	**3.5910**	**0.140**	**0.245**
R3117N363A/C	3.5640	3.6360	**3.5280**	**3.6720**	3.5730	3.6576	**3.5370**	**3.6936**	**0.144**	**0.252**
R3117N373A/C	3.6630	3.7370	**3.6260**	**3.7740**	3.6722	3.7592	**3.6352**	**3.7962**	**0.148**	**0.259**
R3117N383A/C	3.7620	3.8380	**3.7240**	**3.8760**	3.7715	3.8608	**3.7335**	**3.8988**	**0.152**	**0.266**
R3117N393A/C	3.8610	3.9390	**3.8220**	**3.9780**	3.8707	3.9624	**3.8317**	**4.0014**	**0.156**	**0.273**
R3117N403A/C	3.9600	4.0400	**3.9200**	**4.0800**	3.9700	4.0640	**3.9300**	**4.1040**	**0.160**	**0.280**
R3117N413A/C	4.0590	4.1410	**4.0180**	**4.1820**	4.0692	4.1656	**4.0282**	**4.2066**	**0.164**	**0.287**
R3117N423A/C	4.1580	4.2420	**4.1160**	**4.2840**	4.1685	4.2672	**4.1265**	**4.3092**	**0.168**	**0.294**
R3117N433A/C	4.2570	4.3430	**4.2140**	**4.3860**	4.2677	4.3688	**4.2247**	**4.4118**	**0.172**	**0.301**
R3117N443A/C	4.3560	4.4440	**4.3120**	**4.4880**	4.3670	4.4704	**4.3230**	**4.5144**	**0.176**	**0.308**
R3117N453A/C	4.4550	4.5450	**4.4100**	**4.5900**	4.4662	4.5720	**4.4212**	**4.6170**	**0.180**	**0.315**
R3117N463A/C	4.5540	4.6460	**4.5080**	**4.6920**	4.5655	4.6736	**4.5195**	**4.7196**	**0.184**	**0.322**
R3117N473A/C	4.6530	4.7470	**4.6060**	**4.7940**	4.6647	4.7752	**4.6177**	**4.8222**	**0.188**	**0.329**
R3117N483A/C	4.7520	4.8480	**4.7040**	**4.8960**	4.7640	4.8768	**4.7160**	**4.9248**	**0.192**	**0.336**
R3117N493A/C	4.8510	4.9490	**4.8020**	**4.9980**	4.8632	4.9784	**4.8142**	**5.0274**	**0.196**	**0.343**
R3117N503A/C	4.9500	5.0500	**4.9000**	**5.1000**	4.9625	5.0800	**4.9125**	**5.1300**	**0.200**	**0.350**

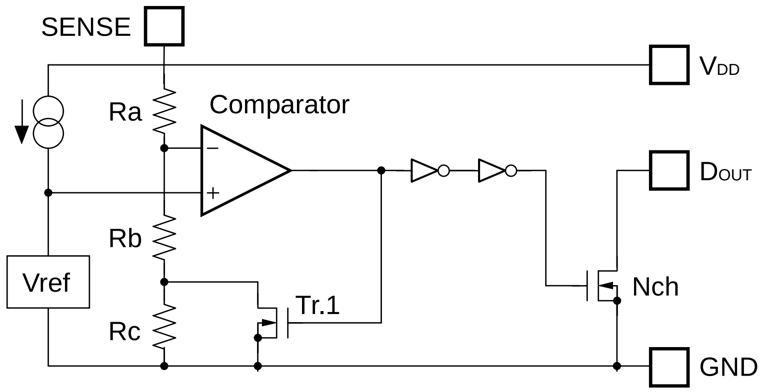
(Ta=25°C)

<table>
<tr><th colspan="2">Sense Resistor</th><th colspan="2">Nch Driver Output Current 1</th><th colspan="2">Nch Driver Output Current2</th><th colspan="2">Pch Driver Output Current</th><th colspan="2">Detector Output Delay Time</th><th colspan="2">Release Output Delay Time</th></tr>
<tr><th colspan="2">R_{SENSE} [MΩ]</th><th colspan="2">I_{OUT1} [μA]</th><th colspan="2">I_{OUT2} [mA]</th><th colspan="2">I_{OUT3} [mA]</th><th colspan="2">t_{PHL} [μs]</th><th colspan="2">t_{PLH} [μs]</th></tr>
<tr><th>Min.</th><th>Typ.</th><th>Cond.</th><th>Min.</th><th>Cond.</th><th>Min.</th><th>Cond.</th><th>Min.</th><th>Cond.</th><th>Typ.</th><th>Cond.</th><th>Typ.</th></tr>
<tr><td rowspan="2">6</td><td rowspan="2">25</td><td rowspan="10">V_{DD}=0.6V
V_{DS}=0.05V</td><td rowspan="10">**7**</td><td>V_{DD}=0.6V
V_{DS}=0.5V</td><td>**0.020**</td><td rowspan="6">V_{DD}=4.5V
V_{DS}=2.1V</td><td rowspan="6">**0.650**</td><td rowspan="4">V_{DD}=5.0V
V_{SENSE}=6.0V
↓
0V
*Note)</td><td rowspan="2">80</td><td rowspan="7">V_{DD}=5.0V
V_{SENSE}=0V
↓
-V_{DET}+2.0V
*Note)</td><td rowspan="8">50</td></tr>
<tr><td rowspan="2">V_{DD}=1.0V
V_{DS}=0.5V</td><td rowspan="2">**0.400**</td></tr>
<tr><td rowspan="7">5</td><td rowspan="8">40</td><td rowspan="8">40</td></tr>
<tr><td rowspan="2">V_{DD}=1.5V
V_{DS}=0.5V</td><td rowspan="2">**1.000**</td></tr>
<tr><td rowspan="6">V_{DD}=5.0V
V_{SENSE}=6.0V
↓
-V_{DET}-2.0V
*Note)</td></tr>
<tr><td rowspan="5">V_{DD}=3.0V
V_{DS}=0.5V</td><td rowspan="5">**2.400**</td></tr>
<tr><td rowspan="4">V_{DD}=6.0V
V_{DS}=2.1V</td><td rowspan="4">**0.900**</td></tr>
<tr><td rowspan="3">V_{DD}=5.0V
V_{SENSE}=0V
↓
6.0V
*Note)</td></tr>
<tr><td rowspan="2">100</td></tr>
<tr><td>10</td></tr>
</table>

Note 1. In the case of CMOS output type:
Time interval from forcing pulsive 6.0V to -V_{DET}-2.0V or 0V, or from forcing 0V to -V_{DET}+2.0V or 6.0V to SENSE pin, to when the output voltage will reach V_{DD}/2.
2. In the case of Nch Open drain output type:
Output pin is pulled up to 5V with 470kΩ and time interval from forcing 6.0V to -V_{DET}-2.0V or 0V, or forcing pulsive 0V to -V_{DET}+2.0V or 6.0V to when the output voltage reaches up to 2.5V.

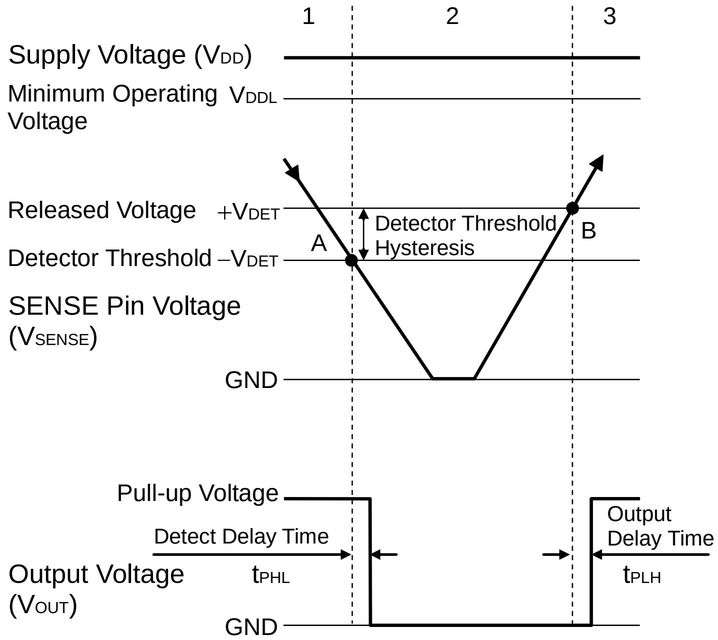
THEORY OF OPERATION

• R3117Nxx3A



D_{OUT} pin should be pulled-up to V_{DD} or an external voltage level.

Block Diagram (R3117Nxx3A)



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

• Explanation

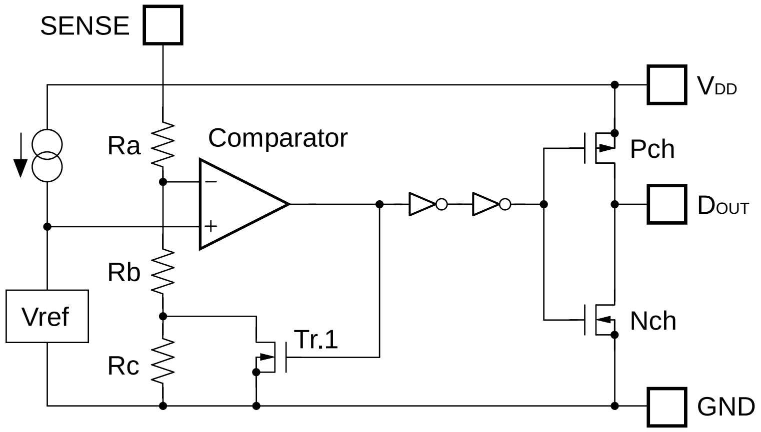
Step 1. The output voltage is equal to the pull-up voltage.

Step 2. At Point "A", Vref $\geqq V_{SENSE} \times (Rb+Rc)/(Ra+Rb+Rc)$ 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 ($-V_{DET}$). (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 GND level.)

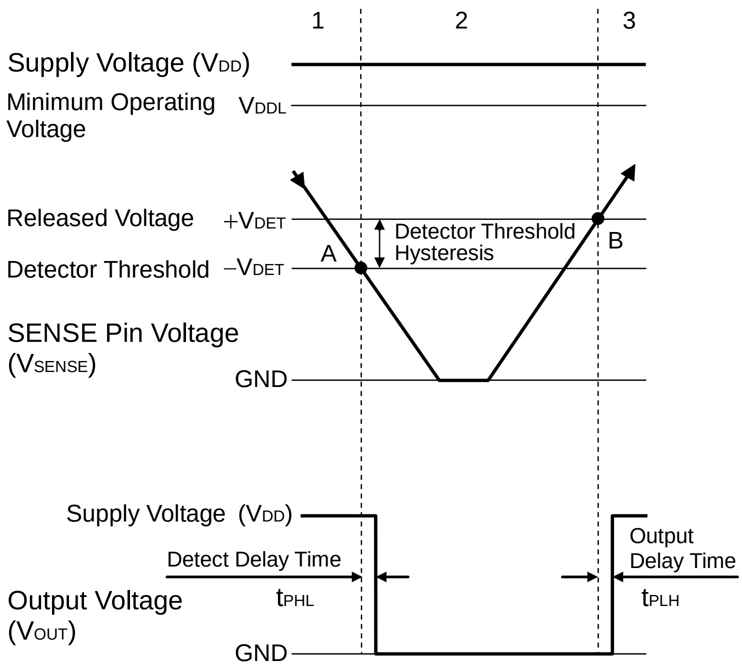
Step 3. At Point "B", Vref $\leqq V_{SENSE} \times Rb/(Ra+Rb)$ is true, as a result, the output of comparator is reversed from "H" to "L", then the output voltage is equal to the pull-up voltage. The voltage level of Point B means a released voltage ($+V_{DET}$).

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

- **R3117Nxx3C**



Block Diagram (R3117Nxx3C)



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

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

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

Operation Diagram

- **Explanation**

Step 1. The output voltage is equal to the supply voltage (V_{DD}).

Step 2. At Point "A", Vref ≧ V_{SENSE}×(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}). (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 GND level.

Step 3. At Point "B", Vref ≦ V_{SENSE}×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 supply voltage (V_{DD}). 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.

- **Power Supply Injection Order**

The R3117Nxx3 supervises 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. Please note that if the V_{DD} voltage enters the shaded area in the Fig.2 after the power activation, it may cause the malfunction.

The vertical axis in the Fig.2 shows the fluctuating magnification of V_{DD}.

For example, when V_{DD} is 1.5V with the released state and if V_{DD} increase to 5.25V (3.5 times) within 100ns, it may cause the malfunction.

If the SENSE pin voltage is equal or more than the released voltage ($+V_{DET}$), D_{OUT} pin becomes "H". Besides, a voltage beyond V_{DD} pin is also acceptable to SENSE pin. Concerning the R3117Nxx3A (Nch open drain output type), D_{OUT} pin must be pulled-up with an external resister.

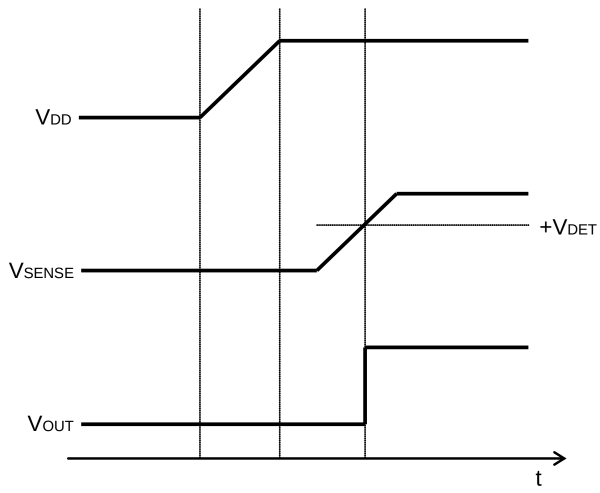


Fig.1 Turn on sequence

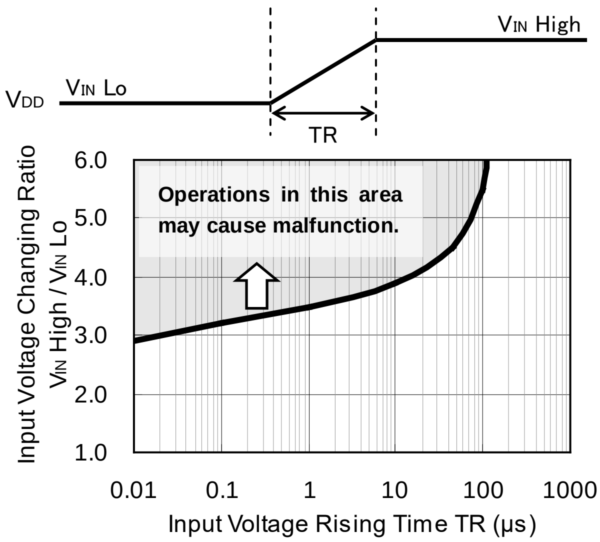


Fig.2

Outside Setting of Detector Threshold

When monitoring the voltage more than 5.0V or the different detector threshold with using lower threshold device, divider resistors can be applied to the SENSE pin. In this usage, some error range will be generated to the detector threshold voltage caused by the internal resistor R_{SENSE} (Refer to Fig.3) of the IC. Supposed that the detector threshold voltage is described as Vs, the next equation will be true.

$V_S = -V_{DET} \times (Ra+Rb)/Rb.$

However, actually an error includes by SENSE resistance (R_{SENSE}) of the IC inside. (Refer to Fig. 4)

$Ia = Ib + I_{SENSE}$ .... (1)

$Ib = -V_{DET} / Rb$ .... (2)

Thus,

$Ia = -V_{DET} / Rb + I_{SENSE}$ .... (3)

Therefore,

$V_S = -V_{DET} + Ia \times Ra$ .... (4)

Put Equation (3) into Equation (4), then

$V_S = -V_{DET} \times (Ra + Rb) / Rb + Ra \times I_{SENSE}$

$Ra \times I_{SENSE}$ is an error in V_S.

$Ra \times I_{SENSE} = Ra \times (-V_{DET}) / R_{SENSE}$
$= -V_{DET} \times Ra / R_{SENSE}$

The error range is $-V_{DET} \times Ra/R_{SENSE}$ (Fig.3) and to make it small, choosing the low detector threshold voltage type and set the resistance values Ra, Rb as R_{SENSE} >>Ra. Refer to the electrical characteristics table to see the R_{SENSE} value.

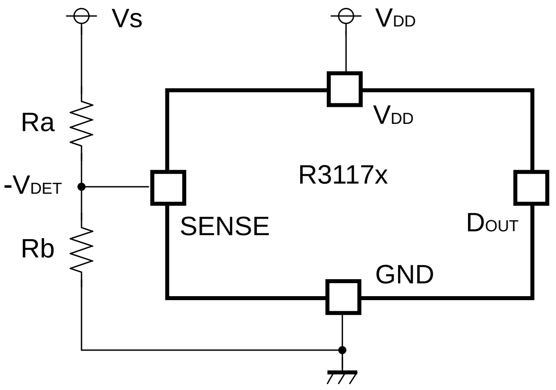


Fig.3

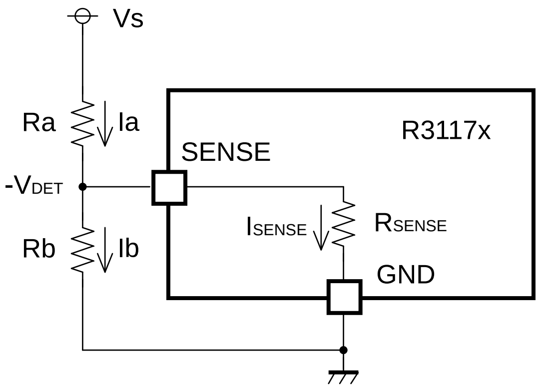


Fig.4

- **Accuracy Detector Threshold**

If the V_{DD} bias voltage is lager than 5.25V, and to keep the detector threshold accuracy level, or if the maximum operating voltage line must be used as the V_{DD} bias voltage, the input voltage must be set low by using the divider resistors which are shown in Fig.5.

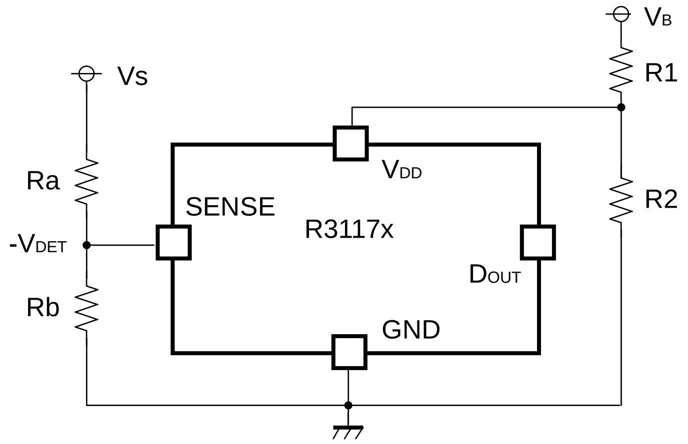
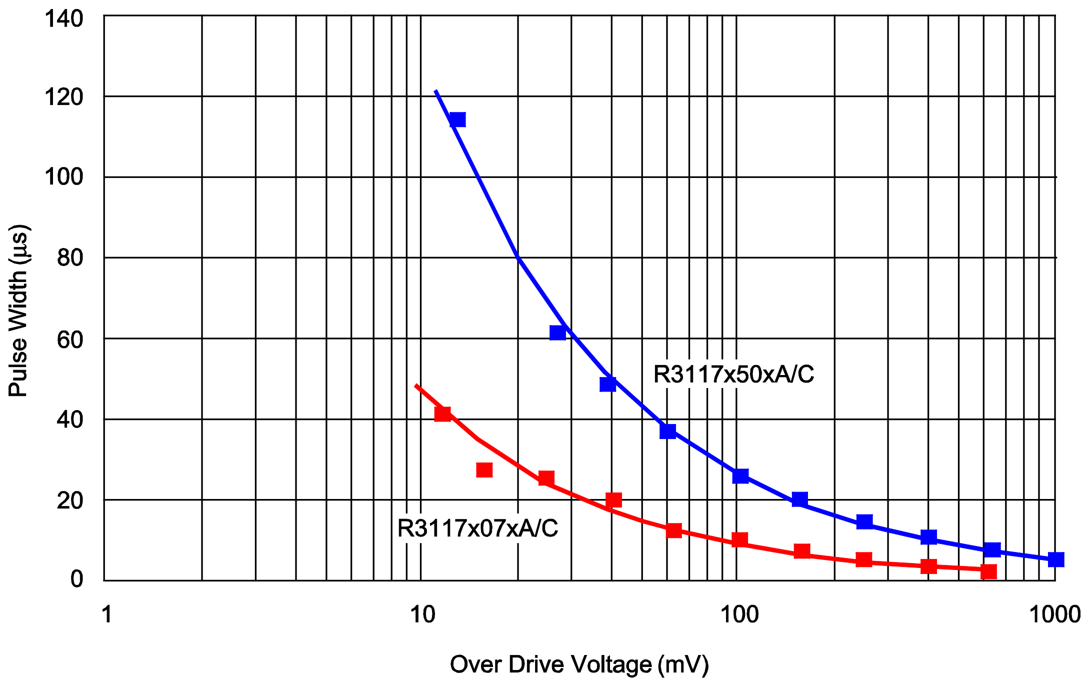
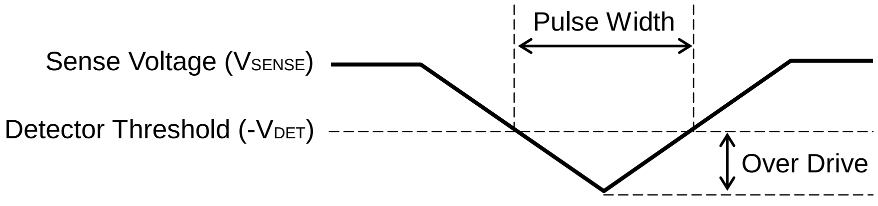


Fig.5

- **Detector Operation vs. glitch input voltage to the SENSE pin**

When the R3117Nxx3 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 R3117Nxx3.

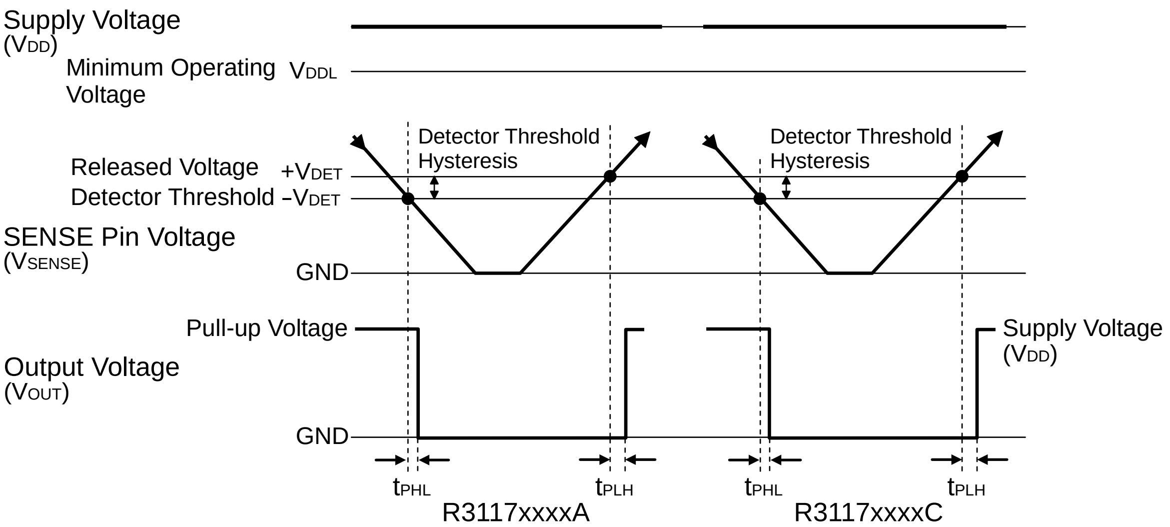




V_{SENSE} Input Waveform

This graph shows the maximum pulse conditions to keep the released voltage. If the pulse with larger amplitude or wider width than the above graph is applied to SENSE pin, the reset signal may be output.

- **Timing Chart**

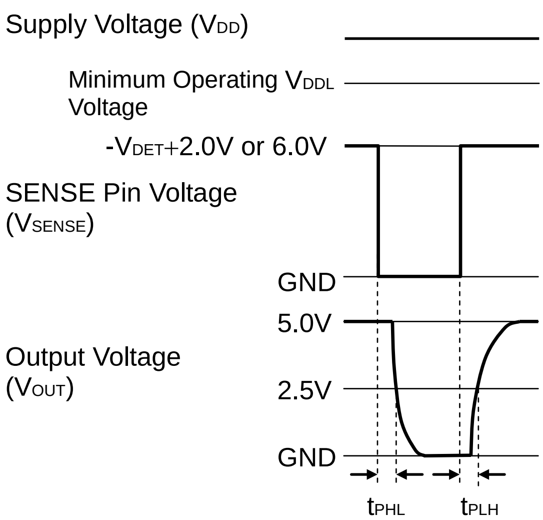


- **Definition of Output Delay Time**

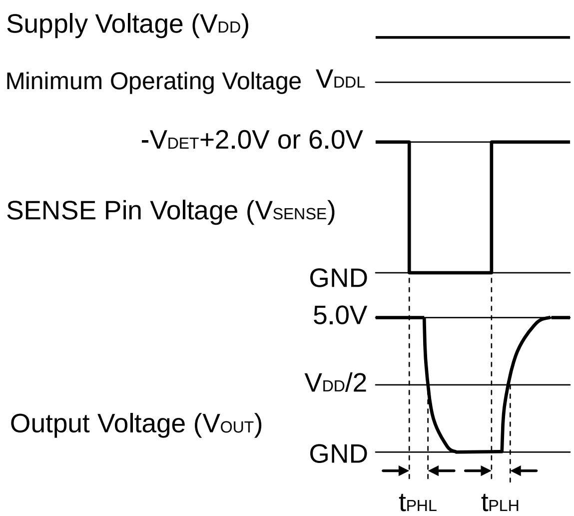
Output Delay Time (t_{PLH}) is defined as follows:

1. In the case of Nch Open Drain Output:
   Under the condition of the output pin (D_{OUT}) is pulled up through a resistor of 470kΩ to 5V, the time interval between the rising edge of SENSE Pin pulse from 0V to ($-V_{DET}$)+2.0V or the time interval of 6.0V pulse voltage is supplied, the becoming of the output voltage to 2.5V.

2. In the case of CMOS Output:
   The time interval between the rising edge of SENSE Pin pulse from 0V to ($-V_{DET}$)+2.0V or the time interval of 6.0V pulse voltage is supplied, the becoming of the output voltage to V_{DD}/2.



Nch Open Drain Output
(R3117Nxx3A)



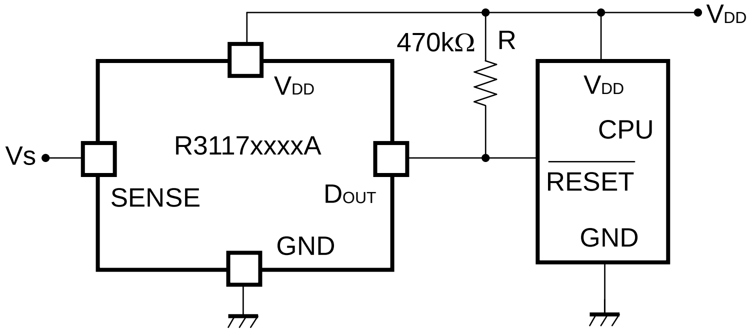
CMOS Output
(R3117Nxx3C)

APPLICATION INFORMATION

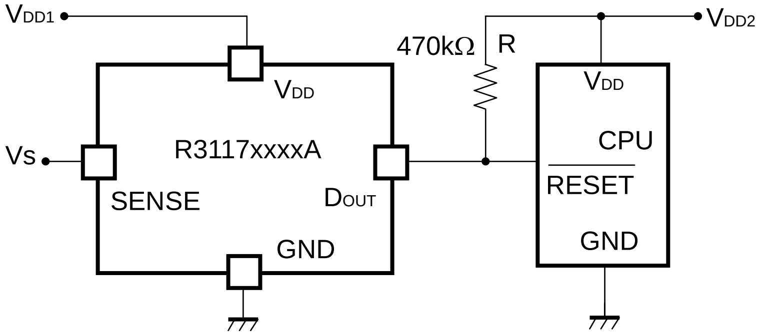
● Typical Application

R3117Nxx3A CPU Reset Circuit (Nch Open Drain Output)

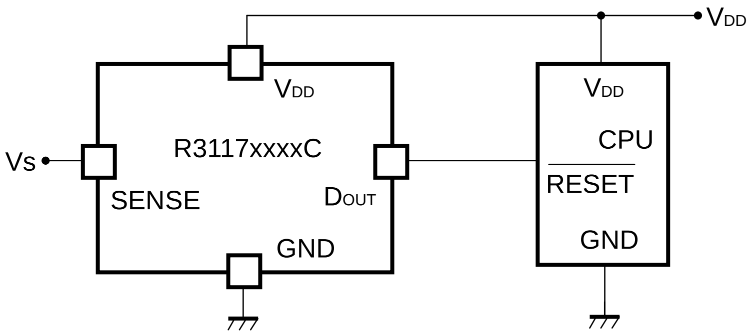
(1) Input Voltage to R3117Nxx3A is equal to Input Voltage to CPU



(2) Input Voltage to R3117Nxx3A is unequal to Input Voltage to CPU



R3117Nxx3C CPU Reset Circuit (CMOS Output)



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.

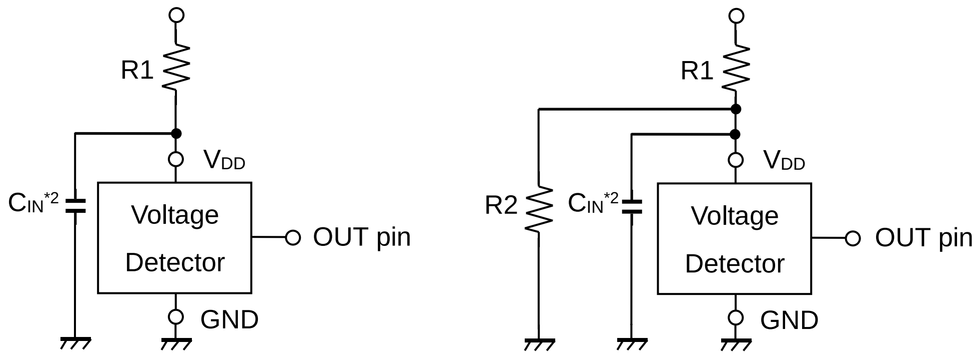


Figure A Figure B

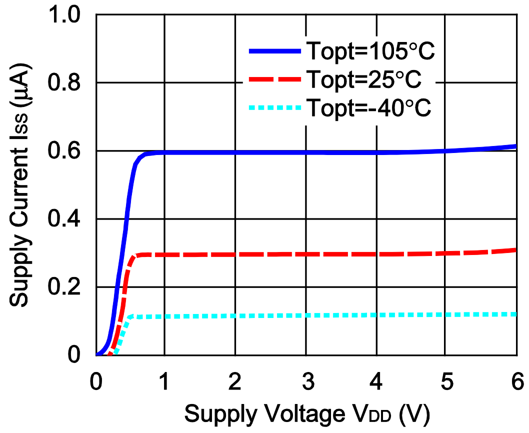
*[1] In the CMOS output type, a charging current for OUT pin is included.
*[2] Note the bias dependence of capacitors.

TYPICAL CHARACTERISTICS

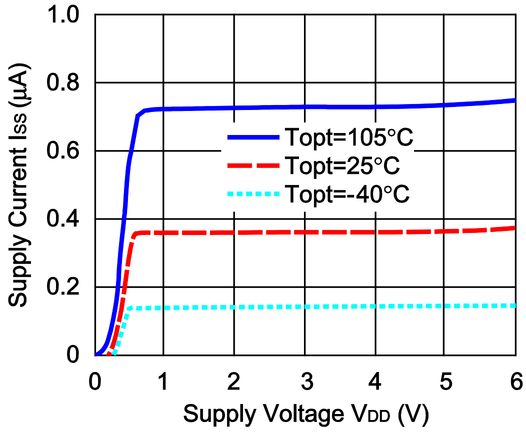
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

1) Supply Current vs. Supply Voltage

R3117xxxxA/C (at released)

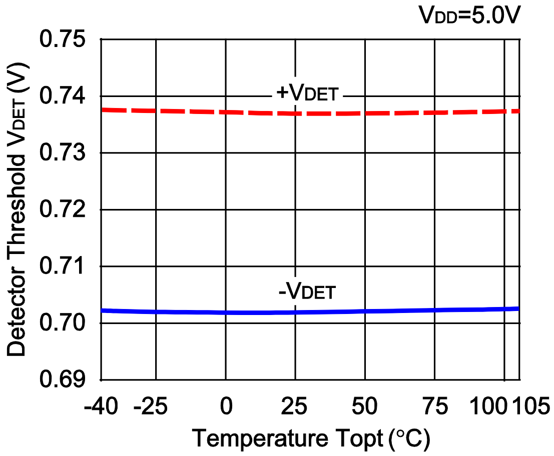


R3117xxxxA/C (at detect)

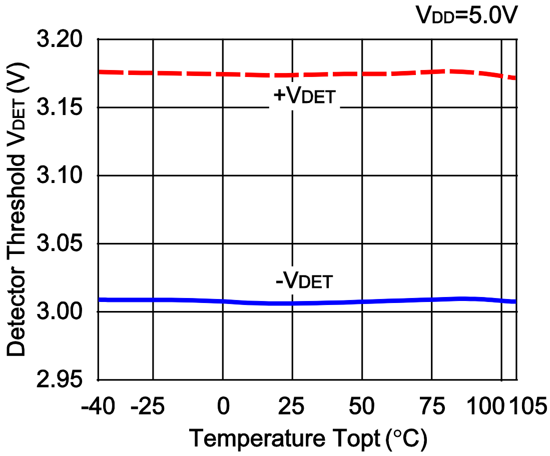


2) Detector Threshold vs. Temperature

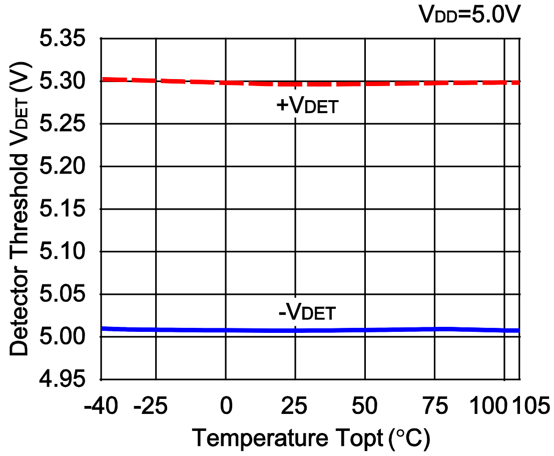
R3117x07xA/C



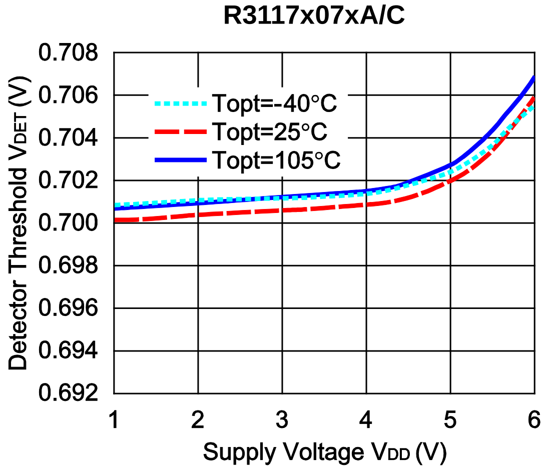
R3117x30xA/C

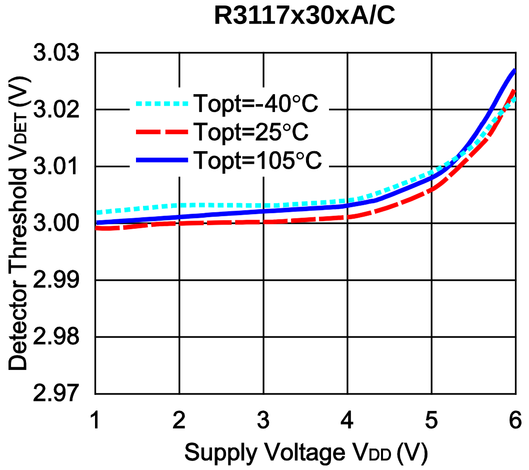


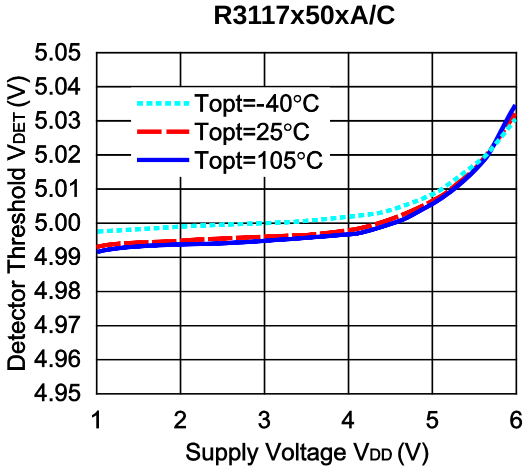
R3117x50xA/C



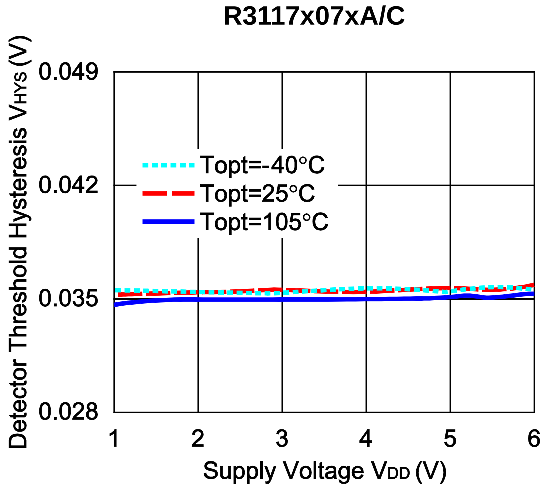
3) Detector Threshold vs. Supply Voltage

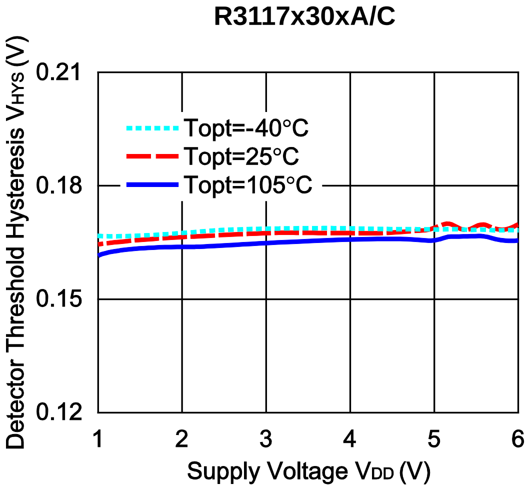


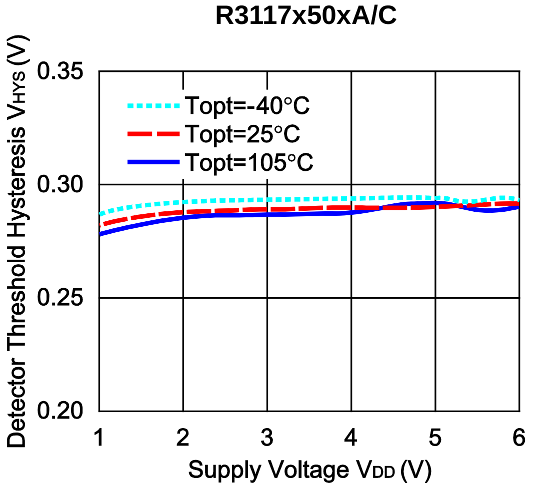




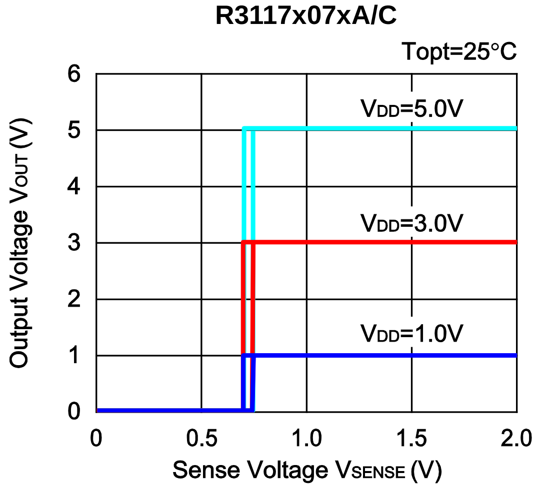
4) Hysteresis vs. Supply Voltage

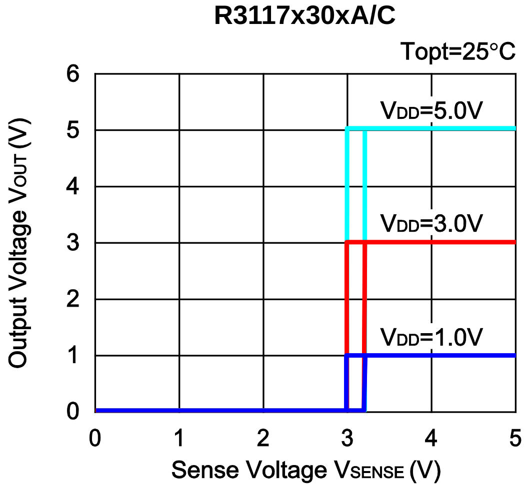


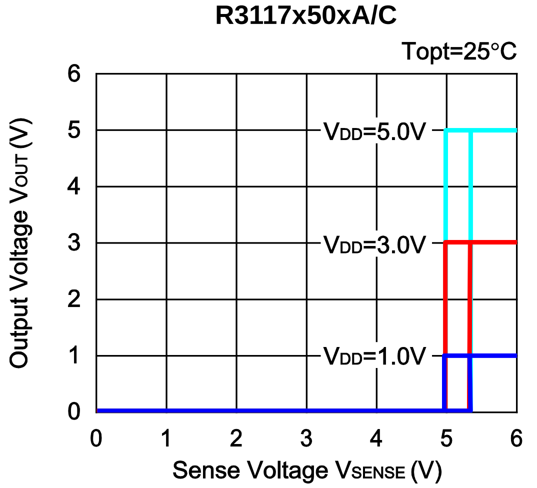




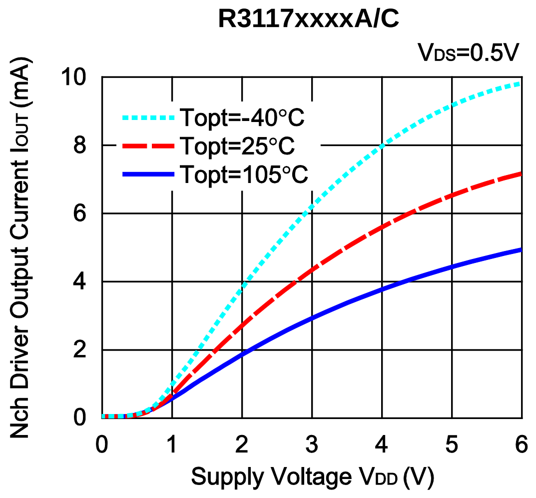
5) Output Voltage vs. SENSE pin Input Voltage (Nch Open Drain Output type is pulled up to V_{DD}.)



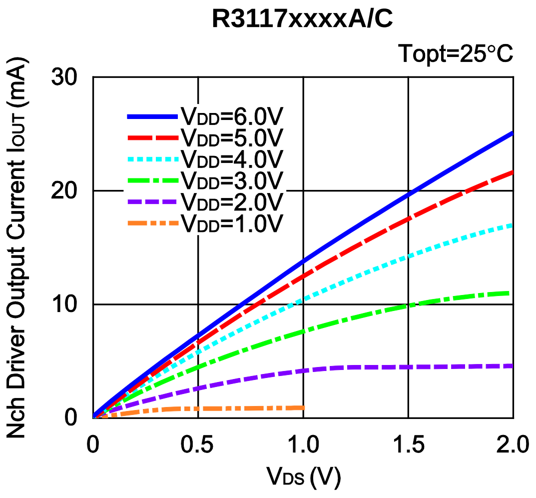




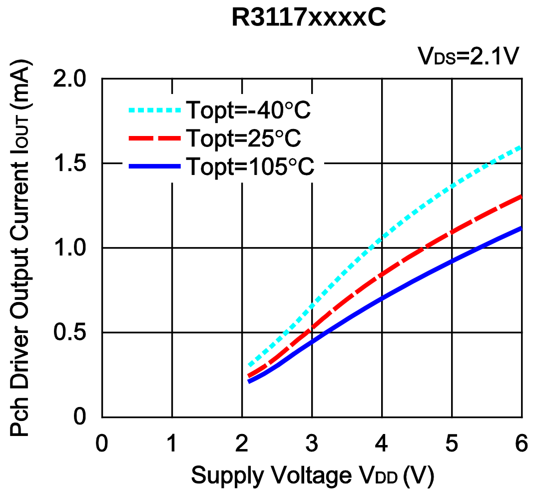
6) Nch Driver Output Current vs. Supply Voltage



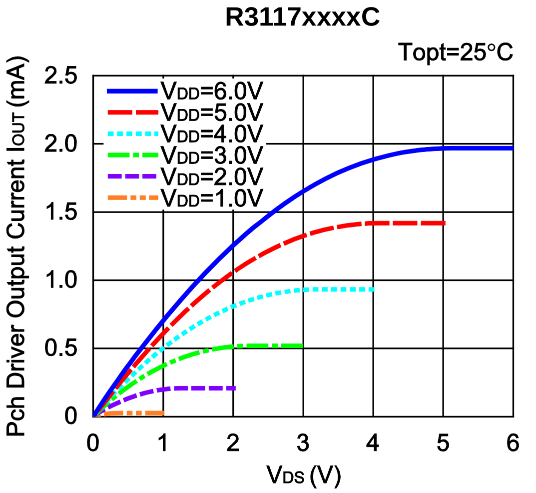
7) Nch Driver Output Current vs. VDS



8) Pch Driver Output Current vs. Supply Voltage



9) Pch Driver Output Current vs. VDS



Ver. A

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

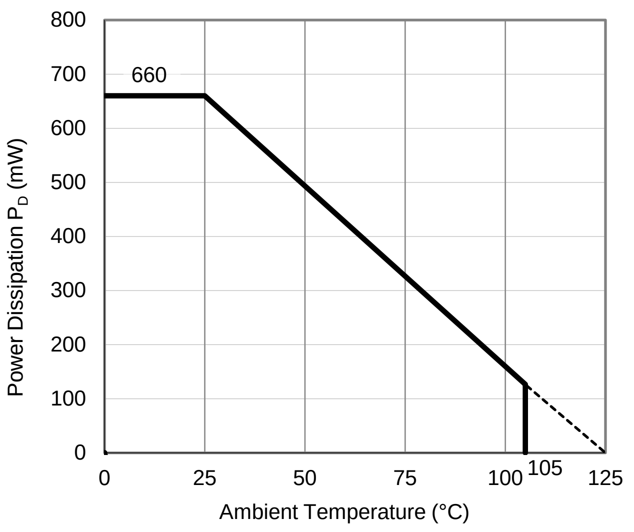
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx.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

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

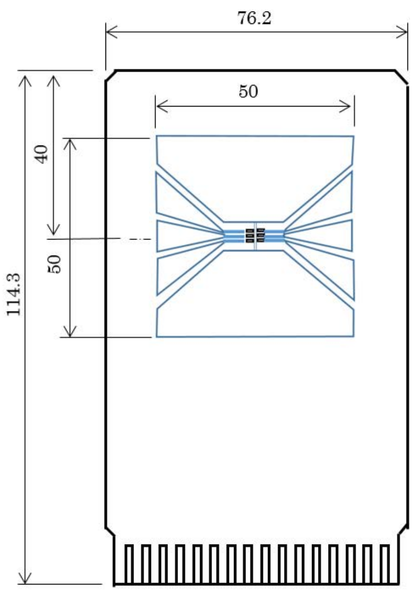
Item	Measurement Result
Power Dissipation	660 mW
Thermal Resistance (θja)	θja = 150°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 51°C/W

θja: Junction-to-Ambient Thermal Resistance

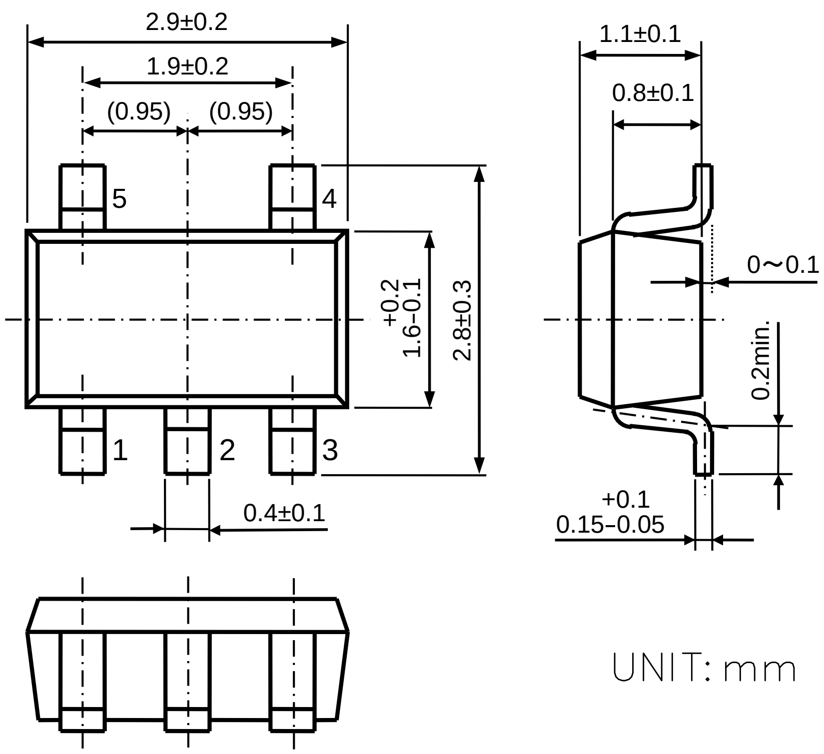
ψjt: Junction-to-Top Thermal Characterization Parameter



Power Dissipation vs. Ambient Temperature



Measurement Board Pattern



SOT-23-5 Package Dimensions

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8. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
9. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
10. There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or our distributor before attempting to use AOI.
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