0.8% Low Voltage Detector with Output Delay for Industrial Applications

NO.EA-347-170203

OUTLINE

The R3116x 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.

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

Two output types, Nch open drain type and CMOS type are available.

R3116x is offered in a 5-pin SOT-23-5 package and an ultra-small 4-pin DFN(PLP)1010-4 package which can achieve the smallest possible footprint solution on boards where area is limited.

This is a high-reliability semiconductor device for industrial applications (-Y) that has passed both the screening at high temperature and the reliability test with extended hours. This line of products operate in a wide temperature range from low temperature to high temperature to support harsh environment applications.

FEATURES

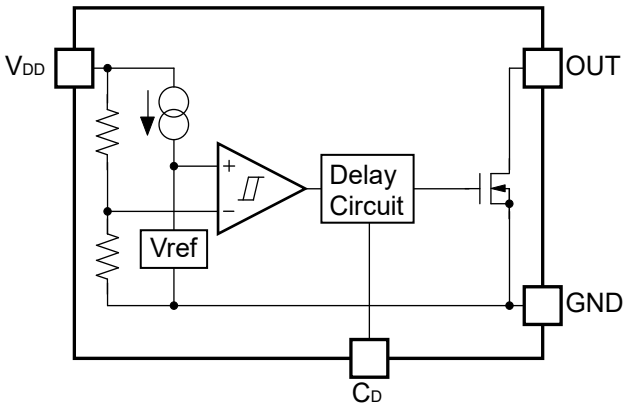
- Operating Voltage Range (Maximum Rating) ..... 0.5V to 6.0V (7.0V)
- Operating Temperature Range ..... −50°C to 105°C
- Supply Current ..... Typ. 0.35μA ($-V_{DET}$=1.5V, V_{DD}=$-V_{DET}$+1V)
- Detector Threshold Range ..... 0.7V to 5.0V (0.1V steps)
- Detector Threshold Accuracy ..... ±0.8% ($-V_{DET} \geq 1.5V$)
- Temperature-Drift Coefficient of Detector Threshold ..... Typ. ±30ppm/°C
- Built-in Output Delay Circuit ..... Typ. 100ms with an external capacitor: 0.022μF
- Output Delay Time Accuracy ..... ±15% ($-V_{DET} \geq 1.5V$)
- Output Types ..... Nch Open Drain and CMOS
- Packages ..... DFN(PLP)1010-4, SOT-23-5

APPLICATIONS

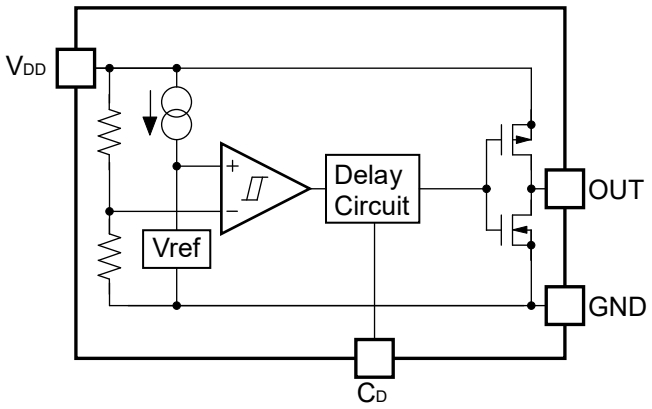
- Industrial equipments such as FAs and smart meters
- Equipments used under high-temperature conditions such as surveillance camera and vending machine
- Equipments accompanied by self-heating such as motor and lighting

BLOCK DIAGRAMS

Nch Open Drain Output (R3116xxx1A)



CMOS Output (R3116xxx1C)



SELECTION GUIDE

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

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R3116Kxx1∗-TR-Y	DFN(PLP)1010-4	10,000 pcs	Yes	Yes
R3116Nxx1∗-TR-YE	SOT-23-5	3,000 pcs	Yes	Yes

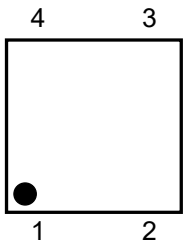
xx : The set detector threshold ($-V_{SET}$) can be designated in the range from 0.7V(07) to 5.0V(50) in 0.1V steps.

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

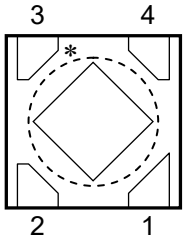
PIN DESCRIPTIONS

● **DFN(PLP)1010-4**

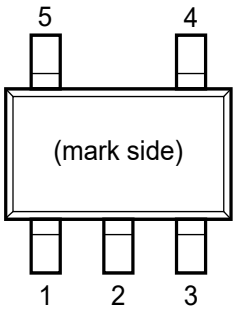
Top View



Bottom View



● **SOT-23-5**



● **DFN(PLP)1010-4**

Pin No.	Symbol	Description
1	OUT	Output Pin ("L" at detection)
2	C_D	Pin for External Capacitor (for setting output delay)
3	GND	Ground Pin
4	V_{DD}	Input Pin

*) The tab on the bottom of the package enhances thermal performance and is electrically connected to GND (substrate level). It is recommended that the tab be connected to the ground plane on the board, or otherwise be left open.

● **SOT-23-5**

Pin No.	Symbol	Description
1	OUT	Output Pin ("L" at detection)
2	V_{DD}	Input Pin
3	GND	Ground Pin
4	NC	No Connection
5	C_D	Pin for External Capacitor (for setting output delay)

ABSOLUTE MAXIMUM RATINGS

Symbol	Item		Rating	Unit
V_{DD}	Supply 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 (DFN(PLP)1010-4)*	Standard Land Pattern	400	mW
	Power Dissipation (SOT-23-5) *	Standard Land Pattern	420	
Tj	Junction Temperature		–50 to 125	°C
Tstg	Storage Temperature Range		–55 to 125	°C

∗ 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 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}	Operating Voltage	0.60 to 6.0	V
Ta	Operating Temperature Range	–50 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 -50°C ≤ Ta ≤ 105°C.

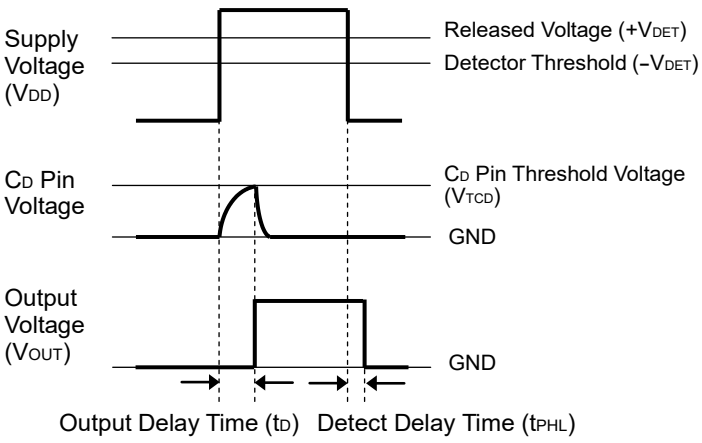
- **R3116xxx1A/C**

(Ta=25°C)

Symbol	Item	Conditions			Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold	Ta=25°C	$1.5V < -V_{DET} \leq 5.0V$		$-V_{DET} \times 0.992$		$-V_{DET} \times 1.008$	V
			$0.7V \leq -V_{DET} \leq 1.5V$		-12		+12	mV
		$-50°C \leq Ta \leq 105°C$	$1.5V < -V_{DET} \leq 5.0V$		$-V_{DET} \times 0.985$		$-V_{DET} \times 1.015$	V
			$0.7V \leq -V_{DET} \leq 1.5V$		-22.5		+22.5	mV
V_{HYS}	Detector Threshold Hysteresis				$-V_{DET} \times 0.04$		$-V_{DET} \times 0.07$	V
I_{SS}	Supply Current	$V_{DD}= -V_{DET} -0.1V$	$0.7V \leq -V_{DET} < 1.6V$				1.400	μA
			$1.6V \leq -V_{DET} < 3.1V$				1.500	
			$3.1V \leq -V_{DET} < 4.1V$				1.600	
			$4.1V \leq -V_{DET} \leq 5.0V$				1.700	
		$V_{DD}= -V_{DET} +1.0V$	$0.7V \leq -V_{DET} < 1.6V$				1.200	
			$1.6V \leq -V_{DET} < 3.1V$				1.200	
			$3.1V \leq -V_{DET} < 4.1V$				1.300	
			$4.1V \leq -V_{DET} \leq 5.0V$				1.400	
V_{DDL}	Minimum Operating Voltage*1	Ta=25°C					0.50	V
		$-40°C \leq Ta \leq 105°C$					0.55	
		$-50°C \leq Ta \leq 105°C$					0.60	V
I_{OUT}	Output Current (Driver Output Pin)	Nch	V_{DD}=0.55V, V_{DS}=0.05V		7			μA
			$0.7V \leq -V_{DET} < 1.1V$	V_{DD}=0.6V, V_{DS}=0.5V	0.020			mA
			$1.1V \leq -V_{DET} < 1.6V$	V_{DD}=1.0V, V_{DS}=0.5V	0.400			
			$1.6V \leq -V_{DET} < 3.1V$	V_{DD}=1.5V, V_{DS}=0.5V	1.000			
			$3.1V \leq -V_{DET} \leq 5.0V$	V_{DD}=3.0V, V_{DS}=0.5V	2.400			
		Pch*2	$0.7V \leq -V_{DET} < 4.0V$	V_{DD}=4.5V, V_{DS}=−2.1V	0.650			mA
			$4.0V \leq -V_{DET} \leq 5.0V$	V_{DD}=6.0V, V_{DS}=−2.1V	0.900			
I_{LEAK}	Nch Driver Leakage Current*3	V_{DD}=6.0V, V_{DS}=7.0V					80	nA
t_D	Output Delay Time	C_D=0.022μF, $V_{DD}=-V_{DET}-0.1V$ to $-V_{DET}$x1.1V	Ta=25°C	$0.7V \leq -V_{DET} < 1.5V$	80	100	130	ms
				$1.5V \leq -V_{DET} \leq 5.0V$	85		115	
			−50°C ≤ Ta ≤ 105°C	$0.7V \leq -V_{DET} < 1.5V$	70	100	150	
				$1.5V \leq -V_{DET} \leq 5.0V$	75		135	

All of unit are tested and specified under load conditions such that Tj≈Ta=25°C
*1 Minimum operating voltage means the value of input voltage when output voltage maintains 0.1V or less.
(In case of Nch Open Drain Output type, the output pin is pulled up with a resistance of 470kΩ to 5.0V)
*2 In case of CMOS type
*3 In case of Nch Open Drain type

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**

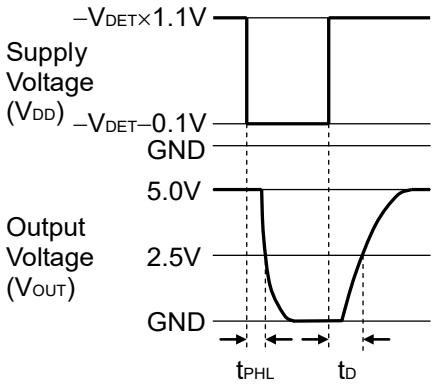
Output Delay Time (t_D) can be calculated with the next formula using the external capacitor:

$t_D(s) = 4.5 \times 10^6 \times C_D(F)$

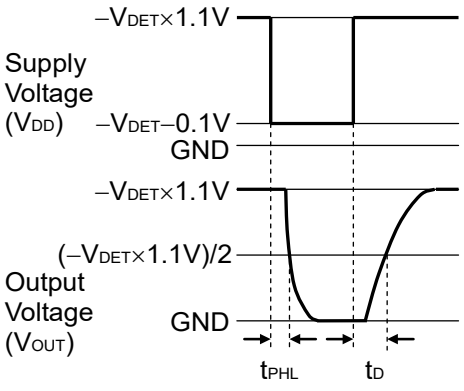
DEFINITION OF OUTPUT DELAY TIME

Output Delay Time (t_D) is defined as follows:

1. In the case of Nch Open Drain Output:
   Under the condition of the output pin (OUT) is pulled up through a resistor of 470kΩ to 5V, the time interval between the rising edge of V_{DD} pulse from (-V_{DET})–0.1V to (-V_{DET})×1.1V 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 V_{DD} pulse from (-V_{DET})–0.1V to (-V_{DET})×1.1V pulse voltage is supplied, the becoming of the output voltage to ((-V_{DET})×1.1V)/2.



Nch Open Drain Output
(R3116xxx1A)



CMOS Output
(R3116xxx1C)

ELECTRICAL CHARACTERISTICS BY DETECTOR THRESHOLD

• R3116x071A/C to R3116x501A/C

Bold values are checked and guaranteed by design engineering at −50°C ≤ Ta ≤ 105°C, unless otherwise noted.

(Ta=25°C)

Part Number	Detector Threshold1		Detector Threshold2		Detector Threshold Hysteresis		Supply Current1		Supply Current2		Max. Op. Voltage	Min. Op. Voltage
	-V_{DET1} [V]		-V_{DET2} [V]		V_{HYS} [V]		I_{SS1} [µA]		I_{SS2} [µA]		V_{DDH} [V]	V_{DDL} [V]
	Min.	Max.	Min.	Max.	Min.	Max.	Cond.	Max.	Cond.	Max.	Max.	Max.
R3116x071A/C	0.688	0.712	**0.678**	**0.723**	**0.028**	**0.049**	V_{DD}= -V_{DET} -0.1V	**1.400**	V_{DD}= -V_{DET} +1.0V	**1.200**	**6**	0.50
R3116x081A/C	0.788	0.812	**0.778**	**0.823**	**0.032**	**0.056**						
R3116x091A/C	0.888	0.912	**0.878**	**0.923**	**0.036**	**0.063**						
R3116x101A/C	0.988	1.012	**0.978**	**1.023**	**0.040**	**0.070**						
R3116x111A/C	1.088	1.112	**1.078**	**1.123**	**0.044**	**0.077**						
R3116x121A/C	1.188	1.212	**1.178**	**1.223**	**0.048**	**0.084**						
R3116x131A/C	1.288	1.312	**1.278**	**1.323**	**0.052**	**0.091**						
R3116x141A/C	1.388	1.412	**1.378**	**1.423**	**0.056**	**0.098**						
R3116x151A/C	1.488	1.512	**1.478**	**1.523**	**0.060**	**0.105**						
R3116x161A/C	1.587	1.613	**1.576**	**1.624**	**0.064**	**0.112**		**1.500**				
R3116x171A/C	1.686	1.714	**1.675**	**1.726**	**0.068**	**0.119**						
R3116x181A/C	1.786	1.814	**1.773**	**1.827**	**0.072**	**0.126**						
R3116x191A/C	1.885	1.915	**1.872**	**1.929**	**0.076**	**0.133**						
R3116x201A/C	1.984	2.016	**1.970**	**2.030**	**0.080**	**0.140**						
R3116x211A/C	2.083	2.117	**2.069**	**2.132**	**0.084**	**0.147**						
R3116x221A/C	2.182	2.218	**2.167**	**2.233**	**0.088**	**0.154**						
R3116x231A/C	2.282	2.318	**2.266**	**2.335**	**0.092**	**0.161**						
R3116x241A/C	2.381	2.419	**2.364**	**2.436**	**0.096**	**0.168**						
R3116x251A/C	2.480	2.520	**2.463**	**2.538**	**0.100**	**0.175**						
R3116x261A/C	2.579	2.621	**2.561**	**2.639**	**0.104**	**0.182**						
R3116x271A/C	2.678	2.722	**2.660**	**2.741**	**0.108**	**0.189**						
R3116x281A/C	2.778	2.822	**2.758**	**2.842**	**0.112**	**0.196**						**0.60**
R3116x291A/C	2.877	2.923	**2.857**	**2.944**	**0.116**	**0.203**						
R3116x301A/C	2.976	3.024	**2.955**	**3.045**	**0.120**	**0.210**						
R3116x311A/C	3.075	3.125	**3.054**	**3.147**	**0.124**	**0.217**		**1.600**		**1.300**		∗Note1
R3116x321A/C	3.174	3.226	**3.152**	**3.248**	**0.128**	**0.224**						
R3116x331A/C	3.274	3.326	**3.251**	**3.350**	**0.132**	**0.231**						
R3116x341A/C	3.373	3.427	**3.349**	**3.451**	**0.136**	**0.238**						
R3116x351A/C	3.472	3.528	**3.448**	**3.553**	**0.140**	**0.245**						
R3116x361A/C	3.571	3.629	**3.546**	**3.654**	**0.144**	**0.252**						
R3116x371A/C	3.670	3.730	**3.645**	**3.756**	**0.148**	**0.259**						
R3116x381A/C	3.770	3.830	**3.743**	**3.857**	**0.152**	**0.266**						
R3116x391A/C	3.869	3.931	**3.842**	**3.959**	**0.156**	**0.273**						
R3116x401A/C	3.968	4.032	**3.940**	**4.060**	**0.160**	**0.280**						
R3116x411A/C	4.067	4.133	**4.039**	**4.162**	**0.164**	**0.287**		**1.700**		**1.400**		
R3116x421A/C	4.166	4.234	**4.137**	**4.263**	**0.168**	**0.294**						
R3116x431A/C	4.266	4.334	**4.236**	**4.365**	**0.172**	**0.301**						
R3116x441A/C	4.365	4.435	**4.334**	**4.466**	**0.176**	**0.308**						
R3116x451A/C	4.464	4.536	**4.433**	**4.568**	**0.180**	**0.315**						
R3116x461A/C	4.563	4.637	**4.531**	**4.669**	**0.184**	**0.322**						
R3116x471A/C	4.662	4.738	**4.630**	**4.771**	**0.188**	**0.329**						
R3116x481A/C	4.762	4.838	**4.728**	**4.872**	**0.192**	**0.336**						
R3116x491A/C	4.861	4.939	**4.827**	**4.974**	**0.196**	**0.343**						
R3116x501A/C	4.960	5.040	**4.925**	**5.075**	**0.200**	**0.350**						

∗Note1) V_{DD} value when output voltage is equal or less than 0.1V. In the case of Nch Open Drain output type, the output pin is pulled up to 5.0V through 470kΩ resistor.

Nch Driver Output Current1		Nch Driver Output Current2		Pch Driver Output Current		Nch Driver Leakage Current		Detector Threshold Temperature Coefficient	Output Delay Time		
I_{OUT1} [µA]		I_{OUT2} [mA]		I_{OUT3} [mA]		I_{LEAK} [nA]		Δ-V_{DET}/ΔTa [ppm/°C]	t_D [ms]		
Cond.	Min.	Cond.	Min.	Cond.	Min.	Cond.	Max.	Typ.	Cond.	Min.	Max.
V_{DD}= 0.55V V_{DS}= 0.05V	**7**	V_{DD}= 0.6V V_{DS}= 0.5V	**0.020**	V_{DD}= 4.5V V_{DS}= -2.1V	**0.650**	V_{DD}= 6.0V V_{DS}= 7.0V	**80**	±30	C_D= 0.022µF V_{DD}= -V_{DET} -0.1V ↓ -V_{DET} ×1.1V ∗Note2	80 **70**	130 **150**
		V_{DD}= 1.0V V_{DS}= 0.5V	**0.400**								
		V_{DD}= 1.5V V_{DS}= 0.5V	**1.000**							85 **75**	115 **135**
		V_{DD}= 3.0V V_{DS}= 0.5V	**2.400**								
				V_{DD}= 6.0V V_{DS}= -2.1V	**0.900**						

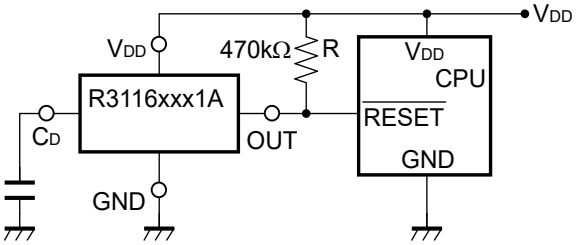
∗Note2) 1. In the case of CMOS output type:
When the voltage is forced from (-V_{DET})–0.1V to (-V_{DET})×1.1V pulse voltage is added to V_{DD}, time interval that the output voltage reaches ((-V_{DET})×1.1V)/2.

2. In the case of Nch Open Drain output type:
The output pin is pulled up to 5.0V through 470kΩ, and when the voltage is forced from (-V_{DET})–0.1V to (-V_{DET})×1.1V pulse voltage is added to V_{DD}, time interval that the output voltage reaches 2.5V.

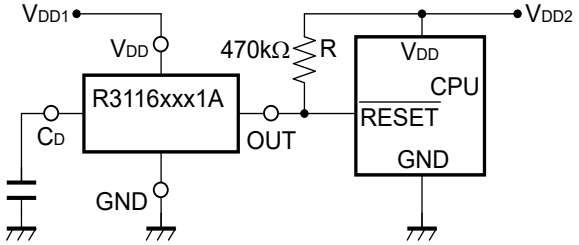
TYPICAL APPLICATION

- **R3116xxx1A CPU Reset Circuit 1 (Nch Open Drain Output)**

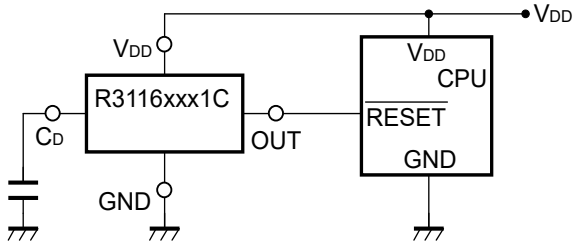
Case1. Input Voltage to R3116xxx1A is equal to Input Voltage to CPU



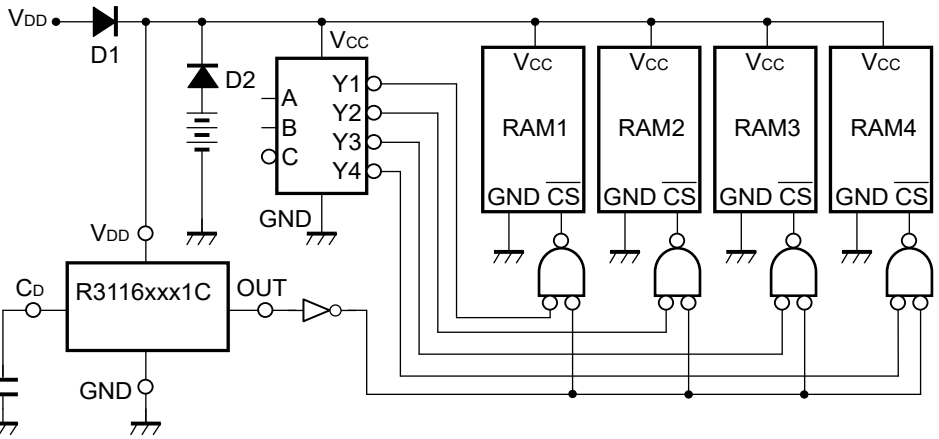
Case2. Input Voltage to R3116xxx1A is unequal to Input Voltage to CPU



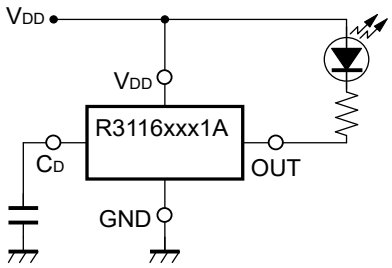
- **R3116xxx1C CPU Reset Circuit 2 (CMOS Output)**



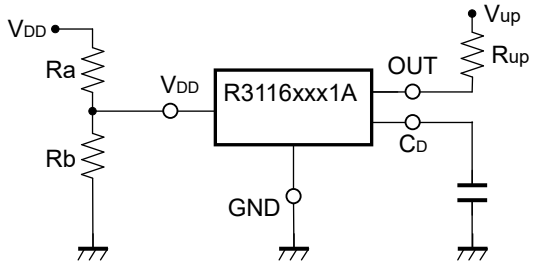
- **Memory Back-up Circuit**



- **Voltage level Indicator Circuit (lighted when the power runs out)**
  (Nch Open Drain Output)



- **Detector Threshold Adjustable Circuit 1**
  (Nch Open Drain Output)

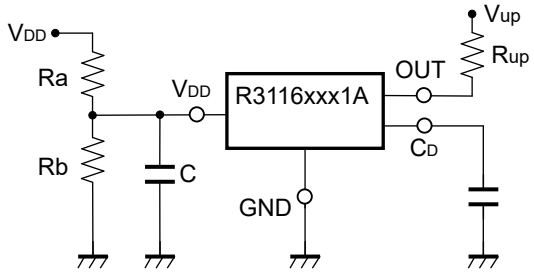


Adjustable Detector Threshold=$(-V_{DET})\times(Ra+Rb)/Rb$

Hysteresis Voltage=$(V_{HYS})\times(Ra+Rb)/Rb$

∗1) To prevent oscillation, set Ra ≦ 1kΩ, Rb ≦ 100Ω.
∗2) If the value of Ra is set excessively large, voltage drop may occur caused by the supply current of IC itself, and detector threshold and hysteresis voltage may vary.
∗3) If Vup and V_{DD} are connected, the voltage dropdown caused by Rup, may cause difference in the hysteresis voltage.

- **Detector Threshold Adjustable Circuit 2**
  (Nch Open Drain Output)

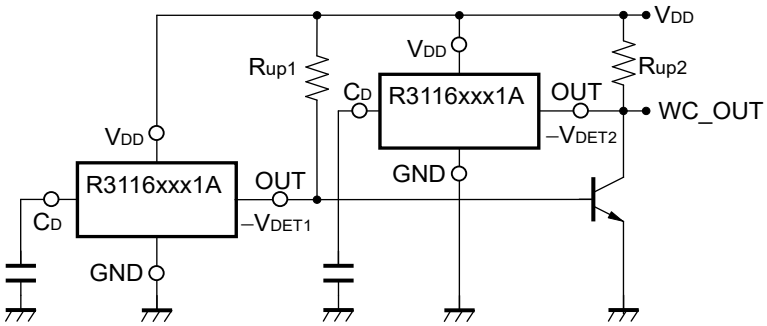


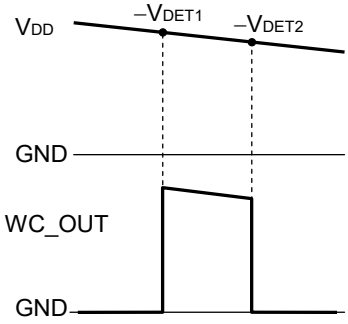
Adjustable Detector Threshold=$(-V_{DET})\times(Ra+Rb)/Rb$

Hysteresis Voltage=$(V_{HYS})\times(Ra+Rb)/Rb$

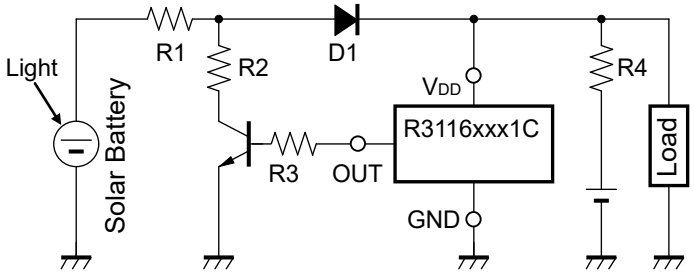
∗1) To prevent oscillation, set Ra ≦ 10kΩ, Rb ≦ 1kΩ, C ≧ 1μF.
∗2) If the value of Ra is set excessively large, voltage drop may occur caused by the supply current of IC itself, and detector threshold and hysteresis voltage may vary.
∗3) If Vup and V_{DD} are connected, the voltage dropdown caused by Rup, may cause difference in the hysteresis voltage.
∗4) If the value of Ra, Rb and C are set excessively large, the delay of the start-up may become too long.

- **Window Comparator Circuit**
  (Nch Open Drain Output)





- **Over-charge Preventing Circuit**



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.

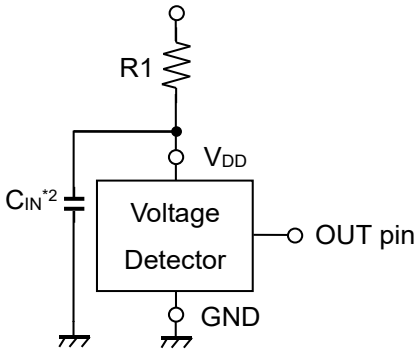


Figure A

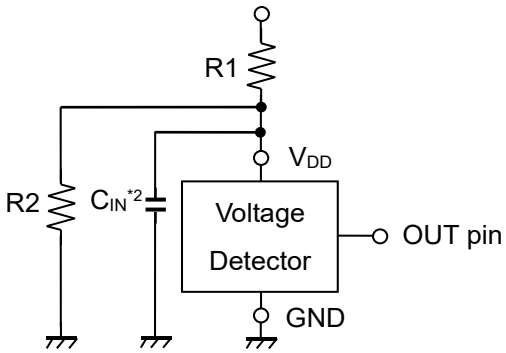


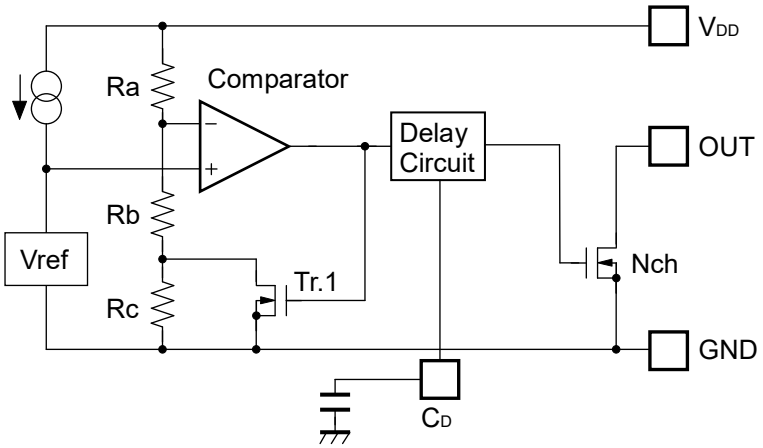
Figure B

*1 In the CMOS output type, a charging current for OUT pin is included.

*2 Note the bias dependence of capacitors.

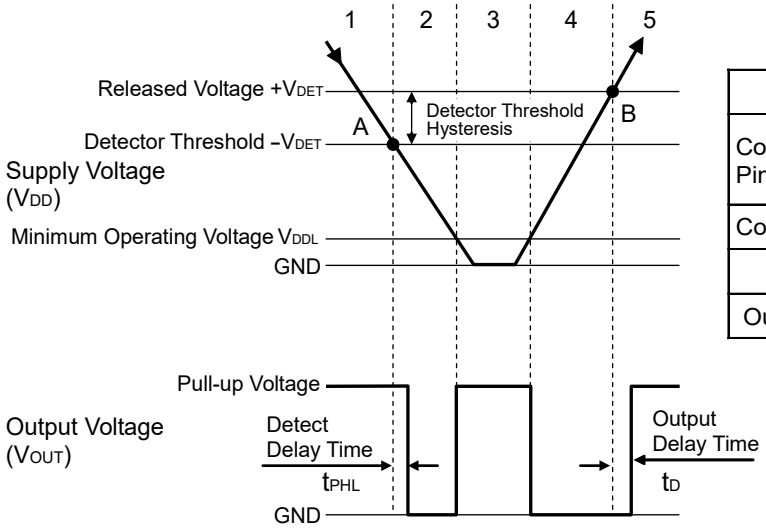
OPERATION

- **Operation of R3116xxx1A**



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

Block Diagram (R3116xxx1A)



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

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

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

Operation Diagram

- **Explanation of operation**

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

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

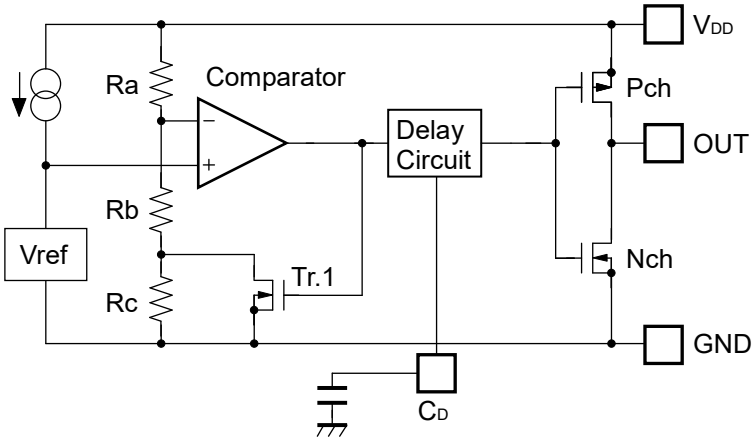
Step 3. When the supply voltage is lower than the minimum operating voltage, the operation of the output transistor becomes indefinite. The output voltage is equal to the pull-up voltage.

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

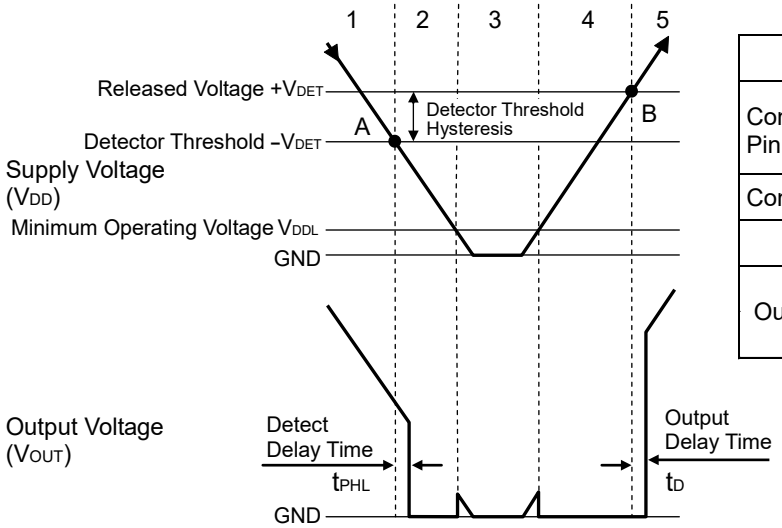
Step 5. At Point "B", Vref ≦ V_{DD}×Rb/(Ra+Rb) is true, as a result, the output of comparator is reversed from "H" to "L", then the output voltage is equal to the pull-up voltage. The voltage level of Point B means a released voltage (+V_{DET}).

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

• Operation of R3116xxx1C



Block Diagram (R3116xxx1C)



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.	Pch	ON	OFF	Indefinite	OFF	ON
	Nch	OFF	ON	Indefinite	ON	OFF

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

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

Operation Diagram

• Explanation of operation

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

Step 2. At Point "A", Vref ≧ V_{DD}×(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.

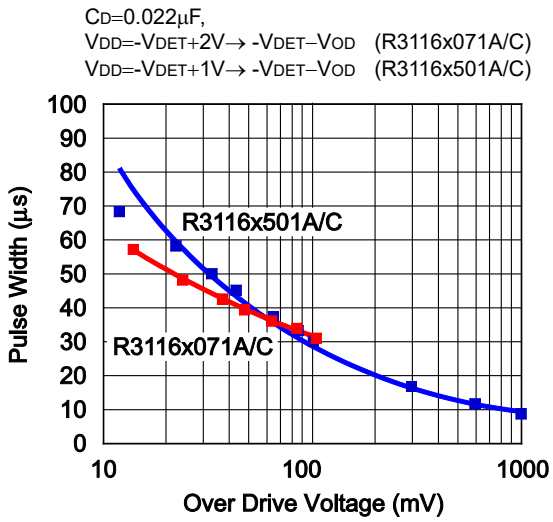
Step 4. The output voltage is equal to the GND level.

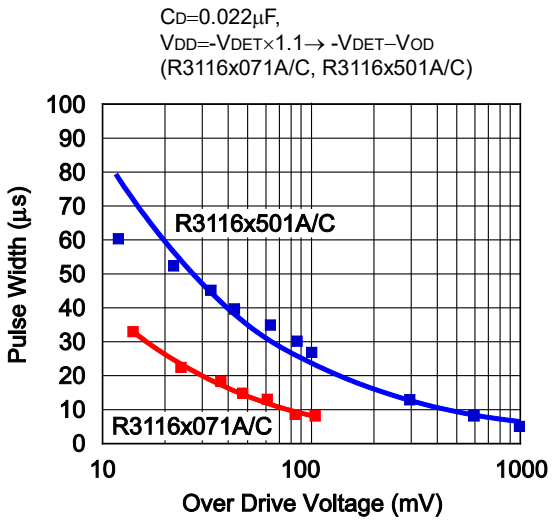
Step 5. At Point "B", Vref ≦ V_{DD}×Rb/(Ra+Rb) is true, as a result, the output of comparator is reversed from "H" to "L", then the output voltage is equal to the supply voltage (V_{DD}). The voltage level of Point B means a released voltage (+V_{DET}).

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

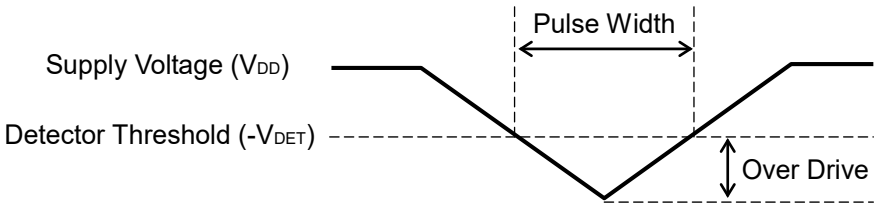
DETECTOR OPERATION VS. GLITCH INPUT VOLTAGE TO THE V_{DD} PIN

When the R3116x 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 R3116x.





∗VOD: Over Drive Voltage



V_{DD} 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 V_{DD} pin, the reset signal may be output.

PACKAGE INFORMATION

POWER DISSIPATION (DFN(PLP)1010-4)

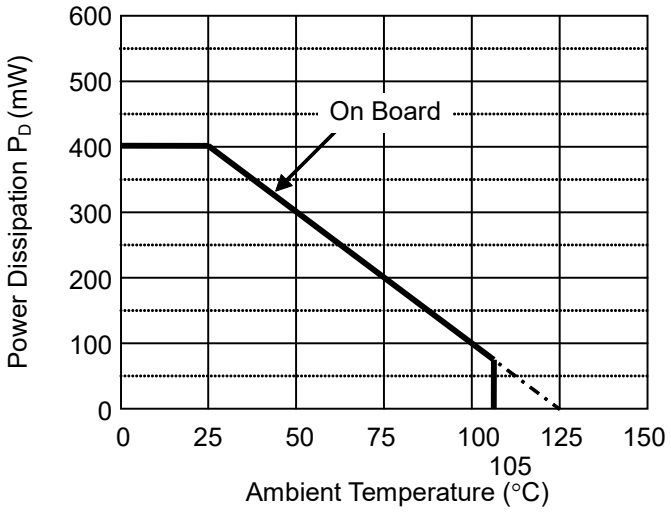
Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

Measurement Conditions

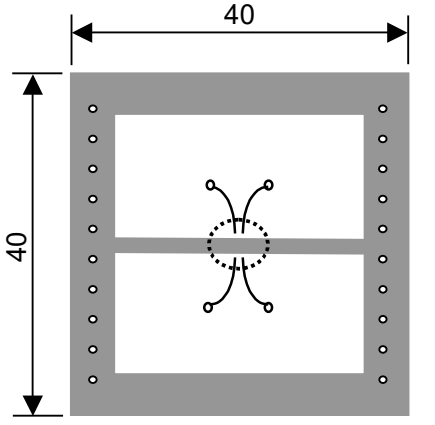
	Standard Test Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm×40mm×1.6mm
Copper Ratio	Top side: Approx. 50%, Back side: Approx. 50%
Through-holes	φ 0.54mm×24pcs

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

	Standard Test Land Pattern
Power Dissipation	400mW
Thermal Resistance	θja = (125-25°C)/0.4W = 250°C/W
	θjc = 67°C/W



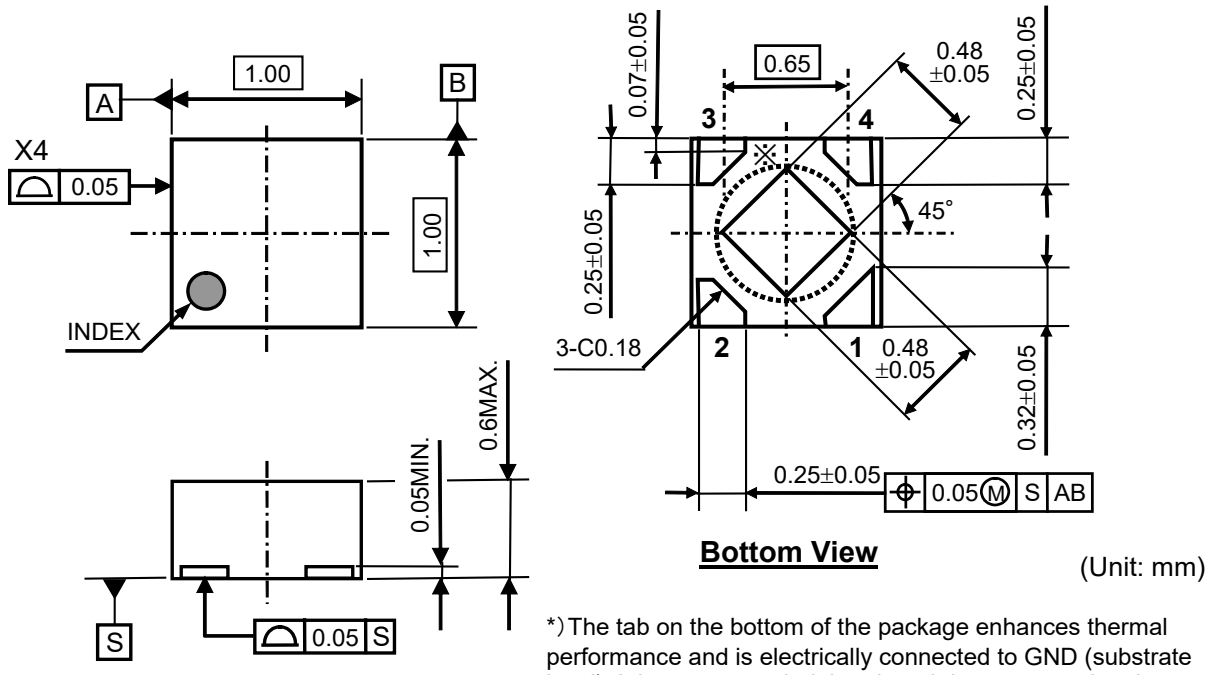
Power Dissipation



Measurement Board Pattern

IC Mount Area (Unit : mm)

PACKAGE DIMENSIONS (DFN(PLP)1010-4)



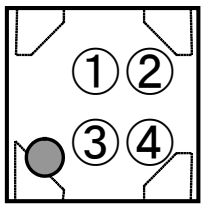
(Unit: mm)

*) The tab on the bottom of the package enhances thermal performance and is electrically connected to GND (substrate level). It is recommended that the tab be connected to the ground plane on the board, or otherwise be left floating.

MARK SPECIFICATION (DFN(PLP)1010-4)

①②: Product Code … **Refer to *MARK SPECIFICATION TABLE***

③④: Lot Number … Alphanumeric Serial Number



MARK SPECIFICATION TABLE (DFN(PLP)1010-4)

R3116Kxx1A

Product Name	①②	V_{SET}
R3116K071A	HA	0.7V
R3116K081A	HB	0.8V
R3116K091A	HC	0.9V
R3116K101A	HD	1.0V
R3116K111A	HE	1.1V
R3116K121A	HF	1.2V
R3116K131A	HG	1.3V
R3116K141A	HH	1.4V
R3116K151A	HJ	1.5V
R3116K161A	HK	1.6V
R3116K171A	HL	1.7V
R3116K181A	HM	1.8V
R3116K191A	HN	1.9V
R3116K201A	HP	2.0V
R3116K211A	HQ	2.1V
R3116K221A	HR	2.2V
R3116K231A	HS	2.3V
R3116K241A	HT	2.4V
R3116K251A	HU	2.5V
R3116K261A	HV	2.6V
R3116K271A	HW	2.7V
R3116K281A	HX	2.8V
R3116K291A	HY	2.9V
R3116K301A	HZ	3.0V
R3116K311A	JA	3.1V
R3116K321A	JB	3.2V
R3116K331A	JC	3.3V
R3116K341A	JD	3.4V
R3116K351A	JE	3.5V
R3116K361A	JF	3.6V
R3116K371A	JG	3.7V
R3116K381A	JH	3.8V
R3116K391A	JJ	3.9V
R3116K401A	JK	4.0V
R3116K411A	JL	4.1V
R3116K421A	JM	4.2V
R3116K431A	JN	4.3V
R3116K441A	JP	4.4V
R3116K451A	JQ	4.5V
R3116K461A	JR	4.6V
R3116K471A	JS	4.7V
R3116K481A	JT	4.8V
R3116K491A	JU	4.9V
R3116K501A	JV	5.0V

R3116Kxx1C

Product Name	①②	V_{SET}
R3116K071C	KA	0.7V
R3116K081C	KB	0.8V
R3116K091C	KC	0.9V
R3116K101C	KD	1.0V
R3116K111C	KE	1.1V
R3116K121C	KF	1.2V
R3116K131C	KG	1.3V
R3116K141C	KH	1.4V
R3116K151C	KJ	1.5V
R3116K161C	KK	1.6V
R3116K171C	KL	1.7V
R3116K181C	KM	1.8V
R3116K191C	KN	1.9V
R3116K201C	KP	2.0V
R3116K211C	KQ	2.1V
R3116K221C	KR	2.2V
R3116K231C	KS	2.3V
R3116K241C	KT	2.4V
R3116K251C	KU	2.5V
R3116K261C	KV	2.6V
R3116K271C	KW	2.7V
R3116K281C	KX	2.8V
R3116K291C	KY	2.9V
R3116K301C	KZ	3.0V
R3116K311C	LA	3.1V
R3116K321C	LB	3.2V
R3116K331C	LC	3.3V
R3116K341C	LD	3.4V
R3116K351C	LE	3.5V
R3116K361C	LF	3.6V
R3116K371C	LG	3.7V
R3116K381C	LH	3.8V
R3116K391C	LJ	3.9V
R3116K401C	LK	4.0V
R3116K411C	LL	4.1V
R3116K421C	LM	4.2V
R3116K431C	LN	4.3V
R3116K441C	LP	4.4V
R3116K451C	LQ	4.5V
R3116K461C	LR	4.6V
R3116K471C	LS	4.7V
R3116K481C	LT	4.8V
R3116K491C	LU	4.9V
R3116K501C	LV	5.0V

POWER DISSIPATION (SOT-23-5)

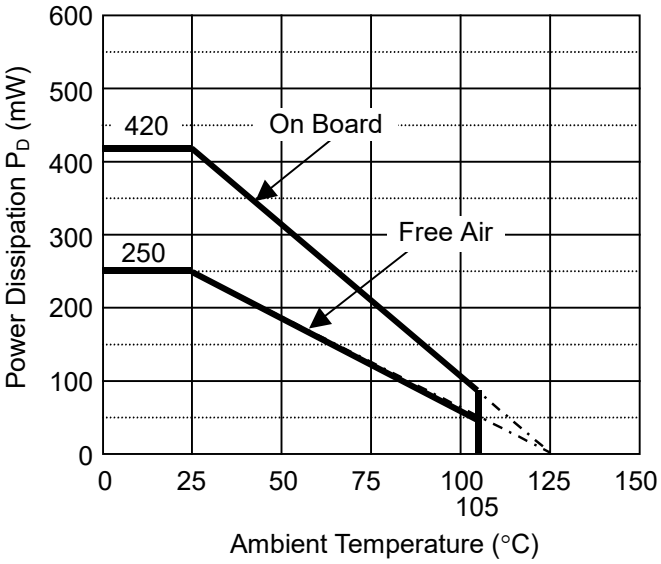
Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:
(Power Dissipation (SOT-23-5) is substitution of SOT-23-6.)

* Measurement Conditions

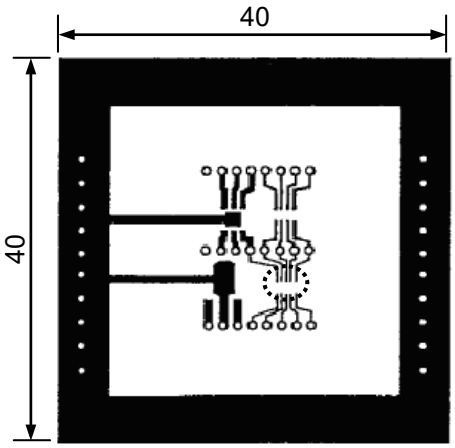
	Standard Test Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm*40mm*1.6mm
Copper Ratio	Top side: Approx. 50%, Back side: Approx. 50%
Through-holes	ϕ 0.5mm * 44pcs

* 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= 238°C/W	400°C/W



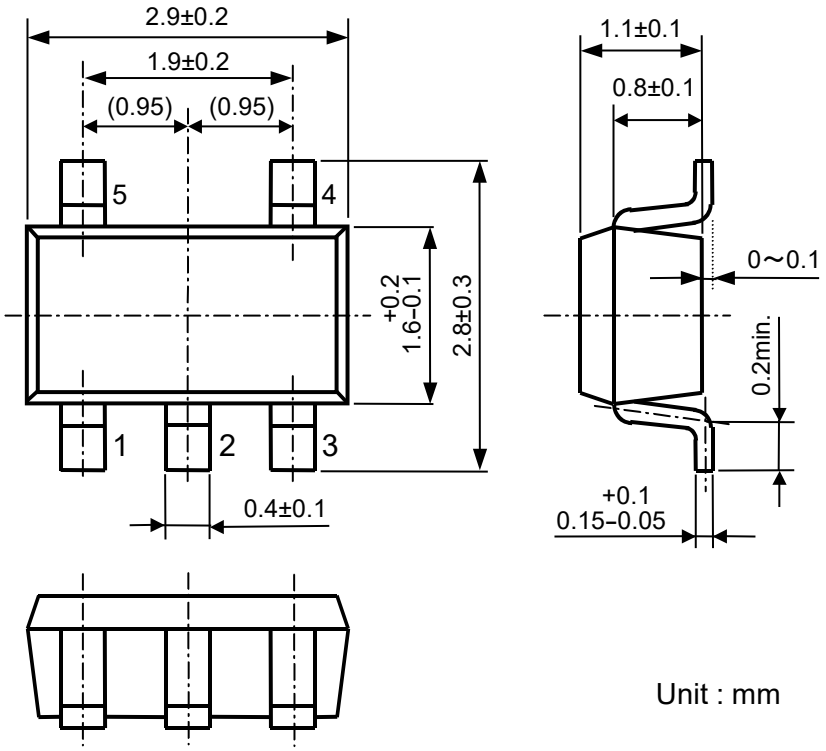
Power Dissipation



Measurement Board Pattern

IC Mount Area (Unit: mm)

PACKAGE DIMENSIONS (SOT-23-5)

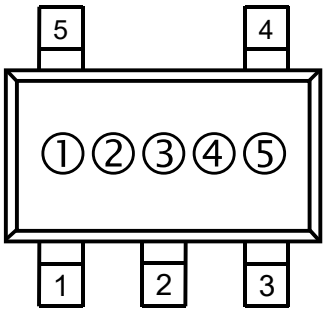


Unit : mm

MARK SPECIFICATION (SOT-23-5)

①②③: Product Code … **Refer to *MARK SPECIFICATION TABLE***

④⑤: Lot Number … Alphanumeric Serial Number



MARK SPECIFICATION TABLE (SOT-23-5)

R3116Nxx1A

Product Name	①②③	V_{SET}
R3116N071A	D 0 A	0.7V
R3116N081A	D 0 B	0.8V
R3116N091A	D 0 C	0.9V
R3116N101A	D 0 D	1.0V
R3116N111A	D 0 E	1.1V
R3116N121A	D 0 F	1.2V
R3116N131A	D 0 G	1.3V
R3116N141A	D 0 H	1.4V
R3116N151A	D 0 J	1.5V
R3116N161A	D 0 K	1.6V
R3116N171A	D 0 L	1.7V
R3116N181A	D 0 M	1.8V
R3116N191A	D 0 N	1.9V
R3116N201A	D 0 P	2.0V
R3116N211A	D 0 Q	2.1V
R3116N221A	D 0 R	2.2V
R3116N231A	D 0 S	2.3V
R3116N241A	D 0 T	2.4V
R3116N251A	D 0 U	2.5V
R3116N261A	D 0 V	2.6V
R3116N271A	D 0 W	2.7V
R3116N281A	D 0 X	2.8V
R3116N291A	D 0 Y	2.9V
R3116N301A	D 0 Z	3.0V
R3116N311A	E 0 A	3.1V
R3116N321A	E 0 B	3.2V
R3116N331A	E 0 C	3.3V
R3116N341A	E 0 D	3.4V
R3116N351A	E 0 E	3.5V
R3116N361A	E 0 F	3.6V
R3116N371A	E 0 G	3.7V
R3116N381A	E 0 H	3.8V
R3116N391A	E 0 J	3.9V
R3116N401A	E 0 K	4.0V
R3116N411A	E 0 L	4.1V
R3116N421A	E 0 M	4.2V
R3116N431A	E 0 N	4.3V
R3116N441A	E 0 P	4.4V
R3116N451A	E 0 Q	4.5V
R3116N461A	E 0 R	4.6V
R3116N471A	E 0 S	4.7V
R3116N481A	E 0 T	4.8V
R3116N491A	E 0 U	4.9V
R3116N501A	E 0 V	5.0V

R3116Nxx1C

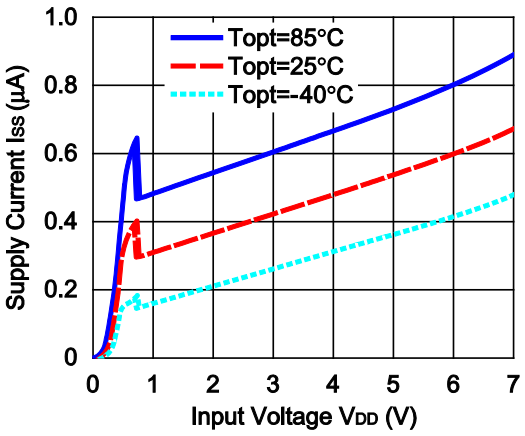
Product Name	①②③	V_{SET}
R3116N071C	D 1 A	0.7V
R3116N081C	D 1 B	0.8V
R3116N091C	D 1 C	0.9V
R3116N101C	D 1 D	1.0V
R3116N111C	D 1 E	1.1V
R3116N121C	D 1 F	1.2V
R3116N131C	D 1 G	1.3V
R3116N141C	D 1 H	1.4V
R3116N151C	D 1 J	1.5V
R3116N161C	D 1 K	1.6V
R3116N171C	D 1 L	1.7V
R3116N181C	D 1 M	1.8V
R3116N191C	D 1 N	1.9V
R3116N201C	D 1 P	2.0V
R3116N211C	D 1 Q	2.1V
R3116N221C	D 1 R	2.2V
R3116N231C	D 1 S	2.3V
R3116N241C	D 1 T	2.4V
R3116N251C	D 1 U	2.5V
R3116N261C	D 1 V	2.6V
R3116N271C	D 1 W	2.7V
R3116N281C	D 1 X	2.8V
R3116N291C	D 1 Y	2.9V
R3116N301C	D 1 Z	3.0V
R3116N311C	E 1 A	3.1V
R3116N321C	E 1 B	3.2V
R3116N331C	E 1 C	3.3V
R3116N341C	E 1 D	3.4V
R3116N351C	E 1 E	3.5V
R3116N361C	E 1 F	3.6V
R3116N371C	E 1 G	3.7V
R3116N381C	E 1 H	3.8V
R3116N391C	E 1 J	3.9V
R3116N401C	E 1 K	4.0V
R3116N411C	E 1 L	4.1V
R3116N421C	E 1 M	4.2V
R3116N431C	E 1 N	4.3V
R3116N441C	E 1 P	4.4V
R3116N451C	E 1 Q	4.5V
R3116N461C	E 1 R	4.6V
R3116N471C	E 1 S	4.7V
R3116N481C	E 1 T	4.8V
R3116N491C	E 1 U	4.9V
R3116N501C	E 1 V	5.0V

TYPICAL CHARACTERISTICS

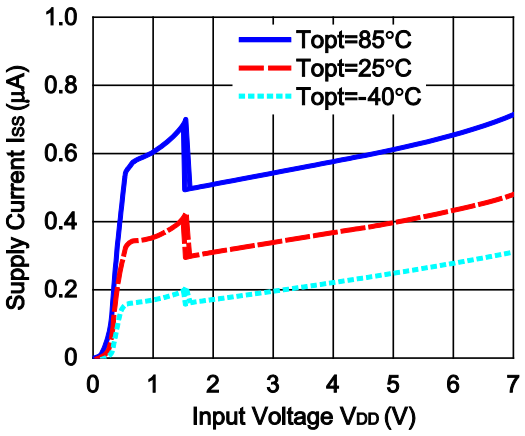
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

1) Supply Current vs. Input Voltage

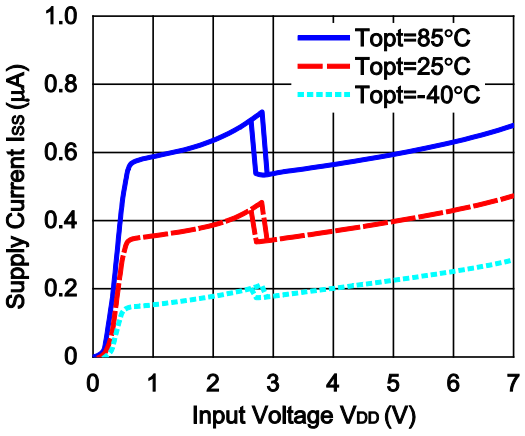
R3116x071A/C



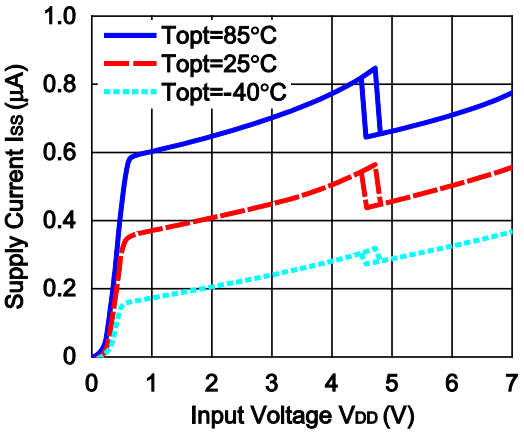
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R3116x271A/C

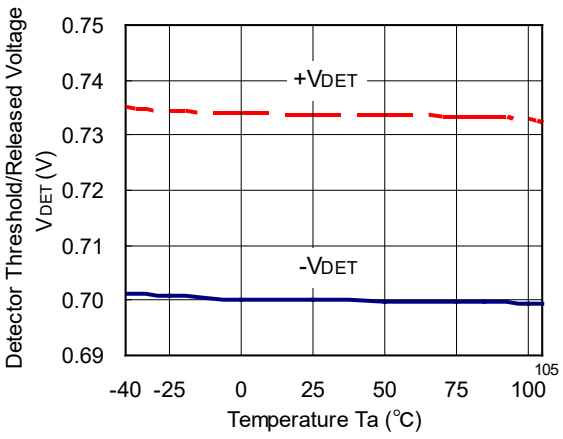


R3116x451A/C

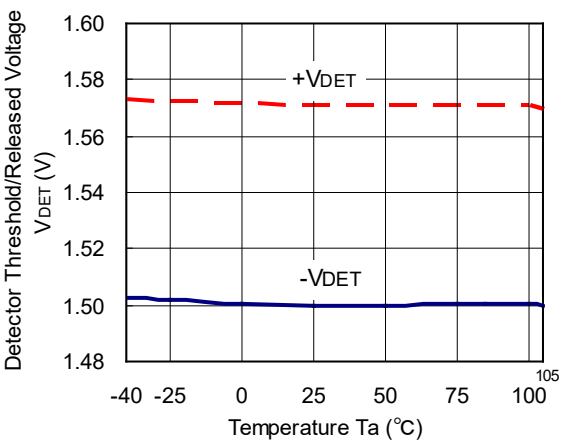


2) Detector Threshold vs. Temperature

R3116x071A/C

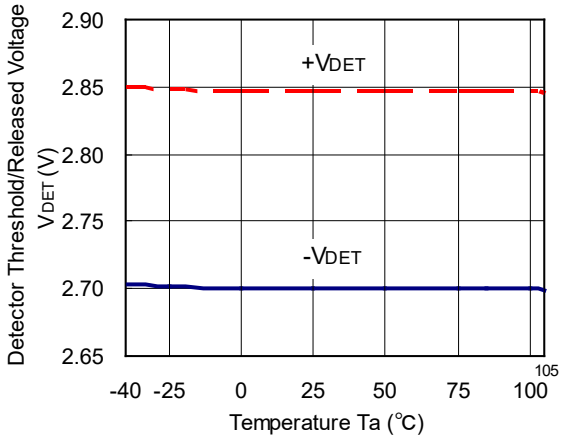


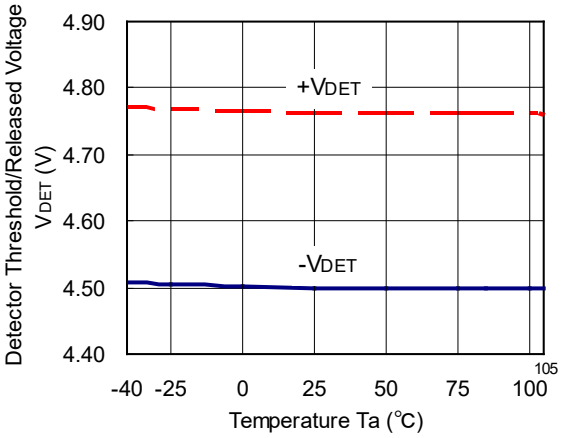
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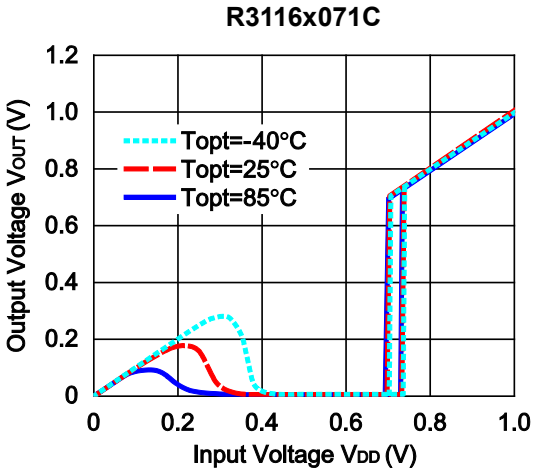
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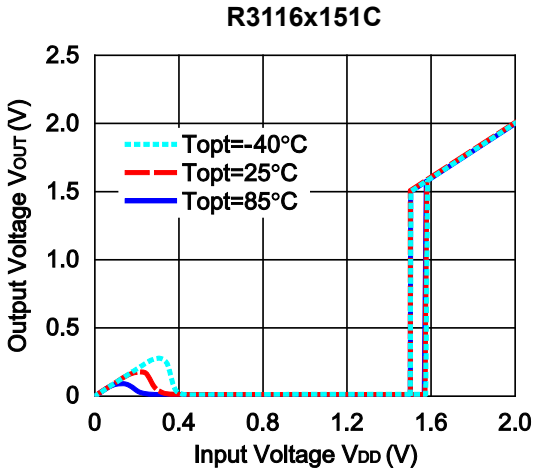
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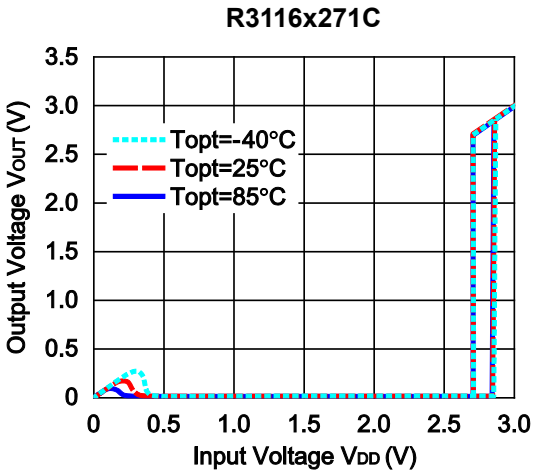


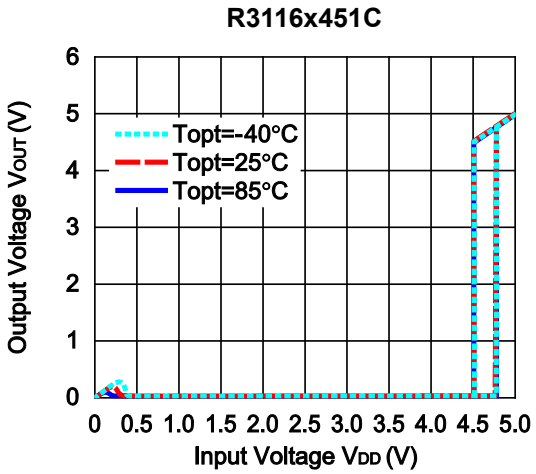


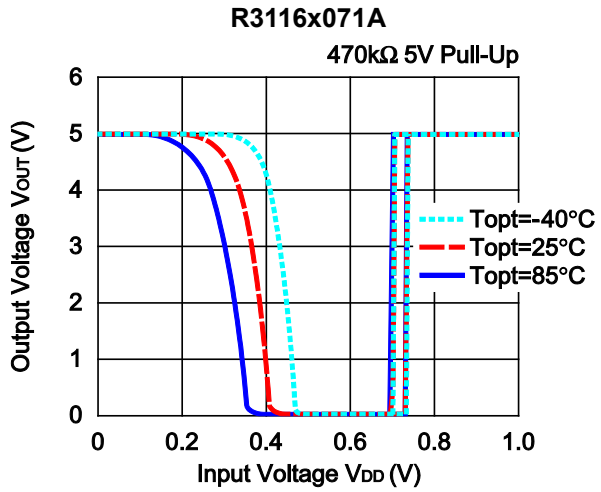
3) Output Voltage vs. Input Voltage

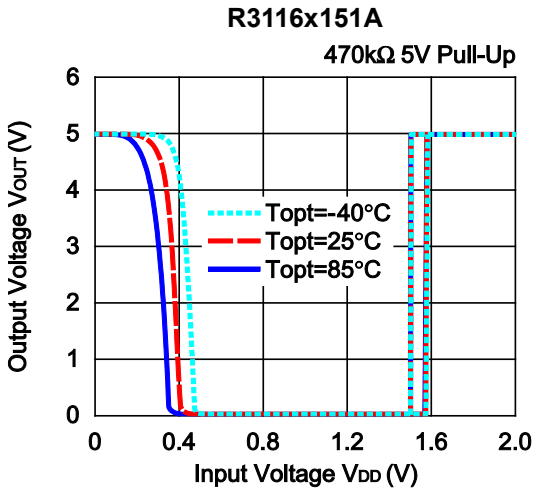


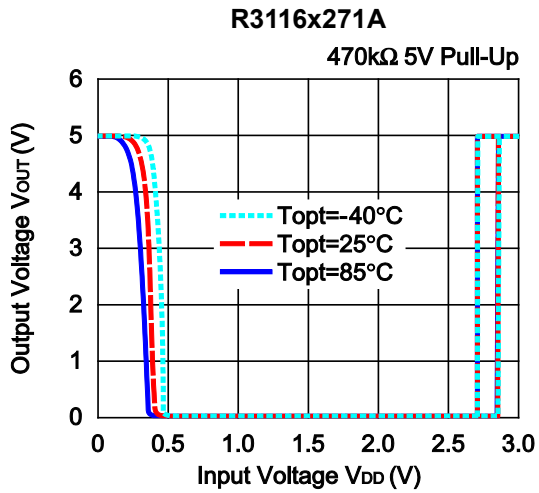


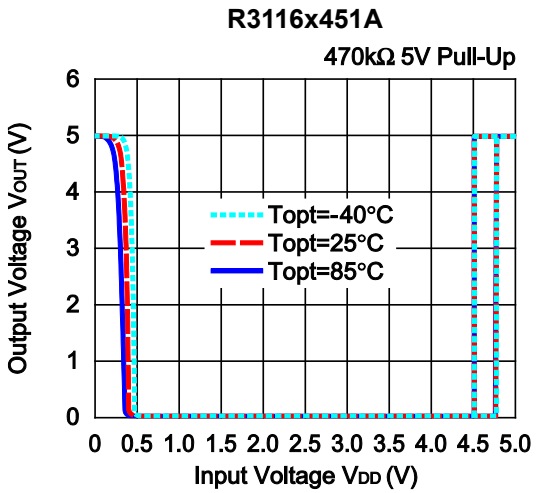




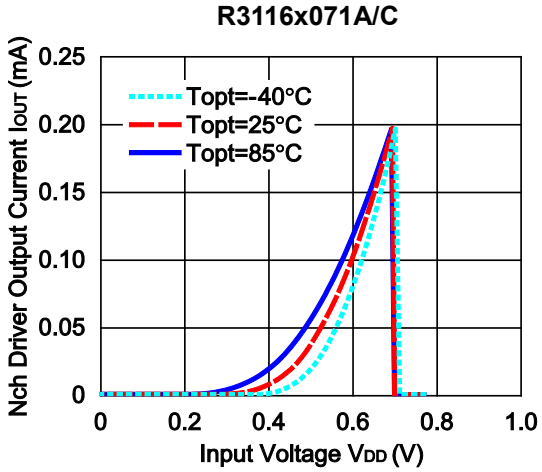


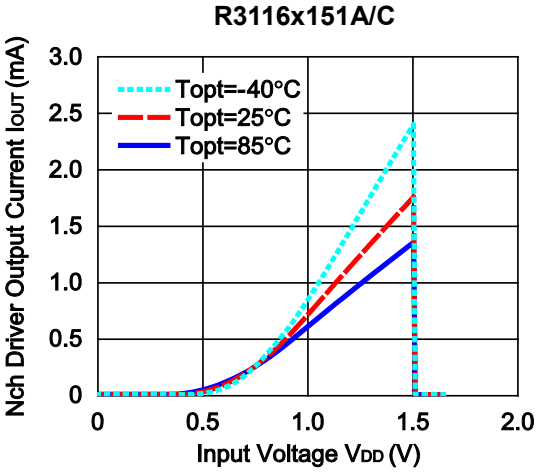




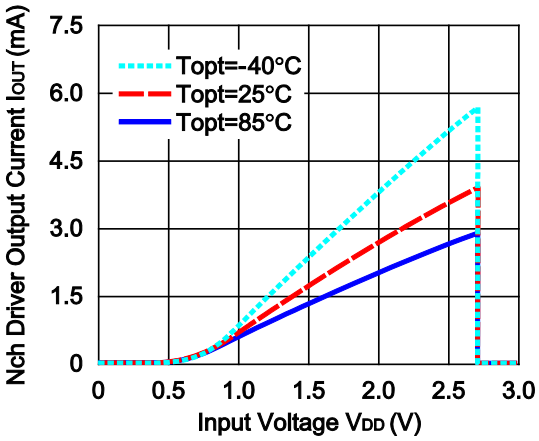


4) Nch Driver Output Current vs. Input Voltage (V_{DS}=0.5V)

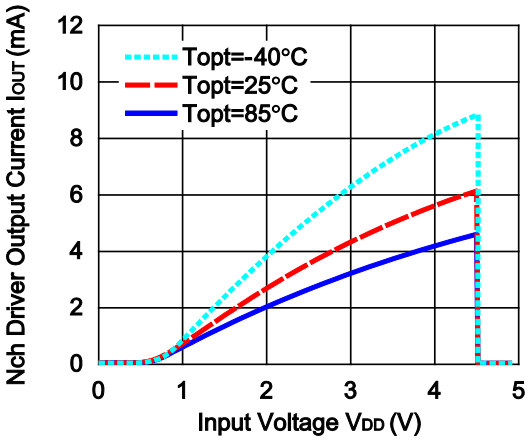




R3116x271A/C

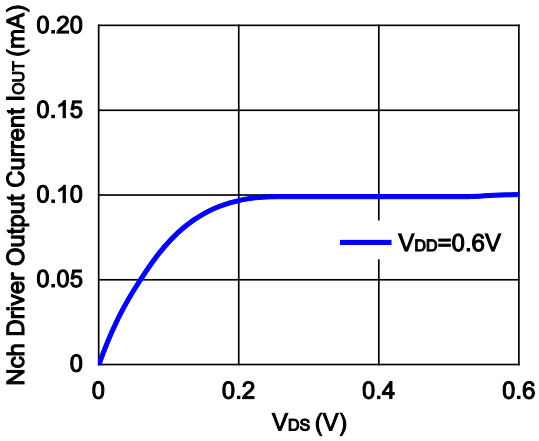


R3116x451A/C

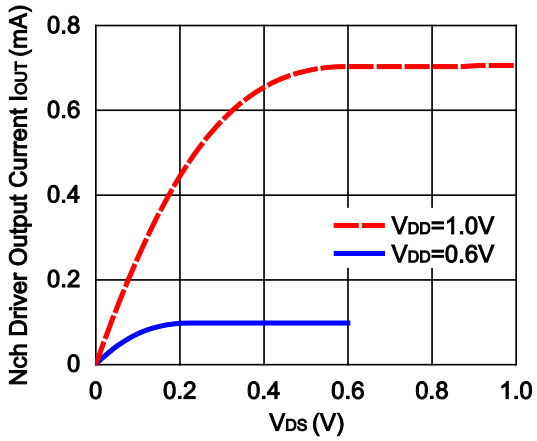


5) Nch Driver Output Current vs. VDS

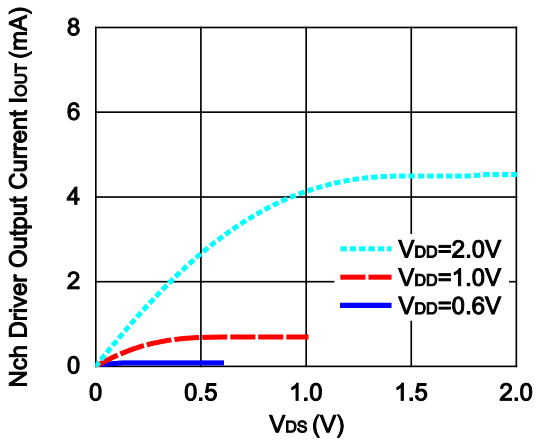
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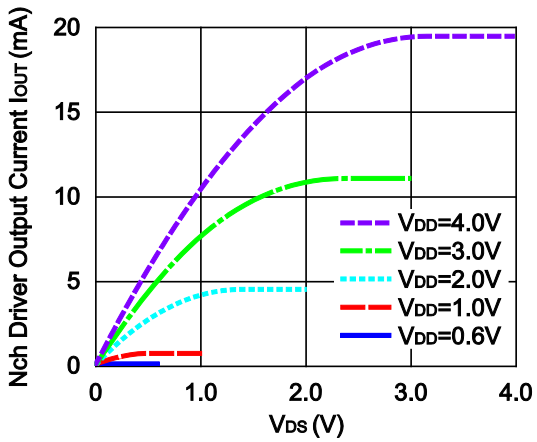
R3116x151A/C



R3116x271A/C

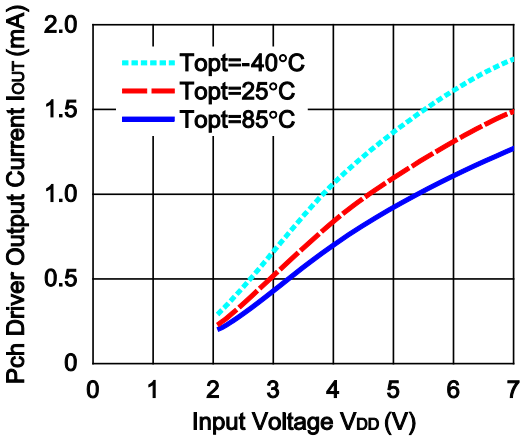


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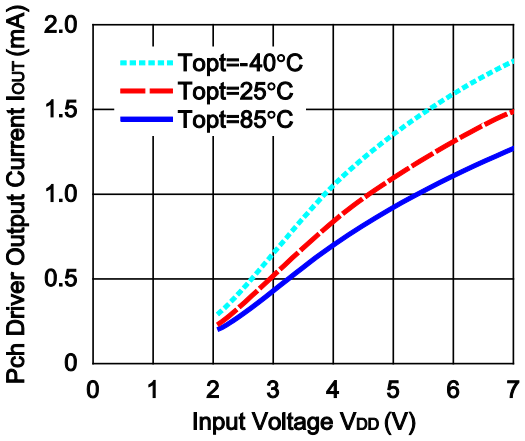


6) Pch Driver Output Current vs. Input Voltage (V_{DS}=–2.1V)

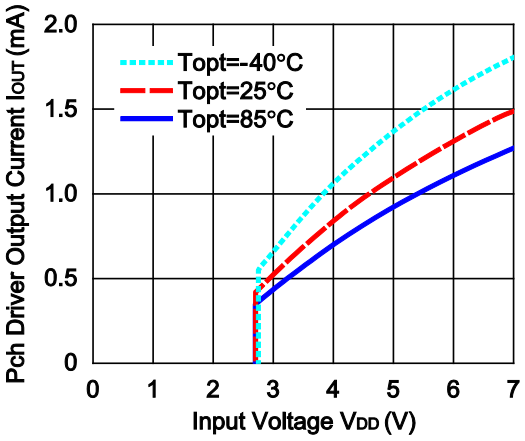
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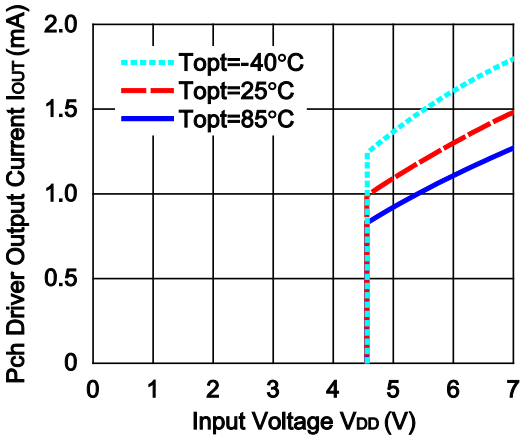
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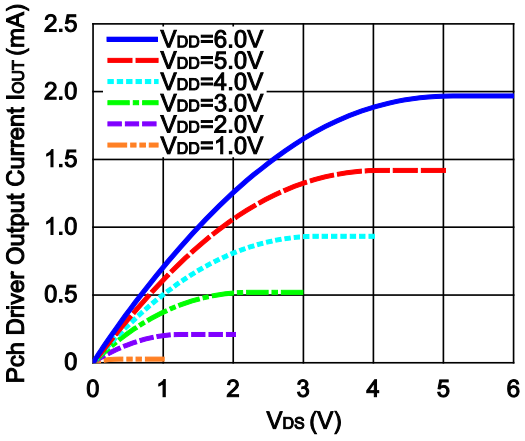


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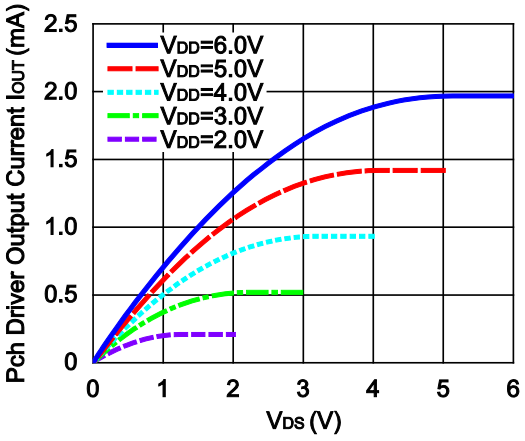


7) Pch Driver Output Current vs. V_{DS}

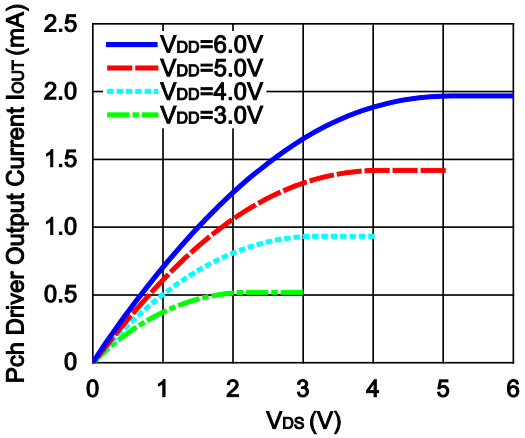
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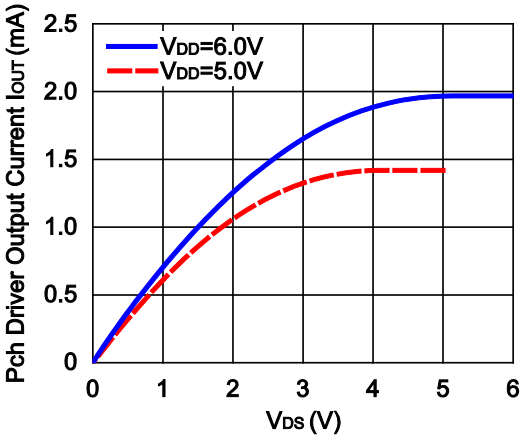
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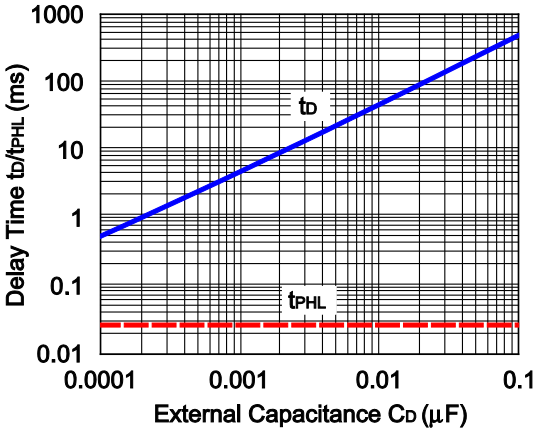


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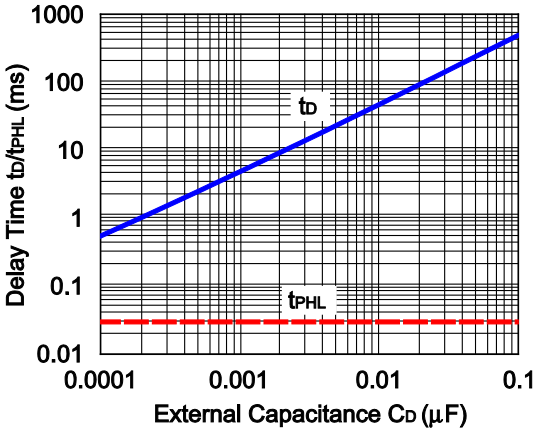


8) Output Delay Time vs. External Capacitance

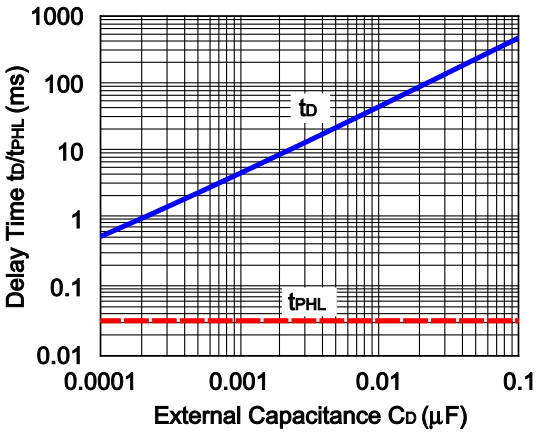
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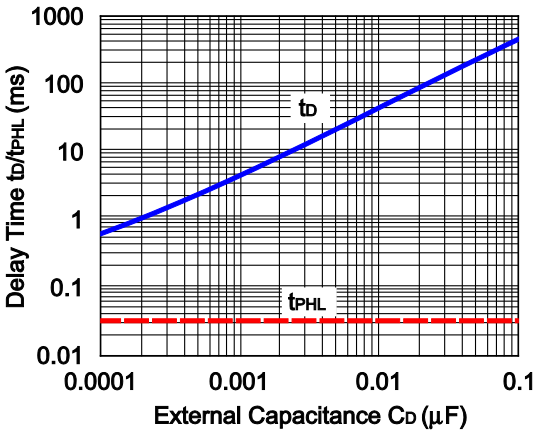
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R3116x271A/C

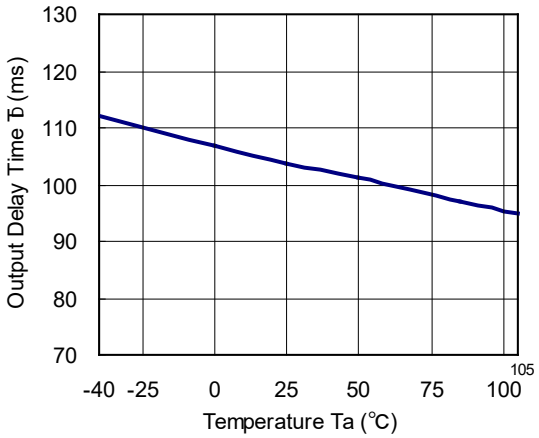


R3116x451A/C

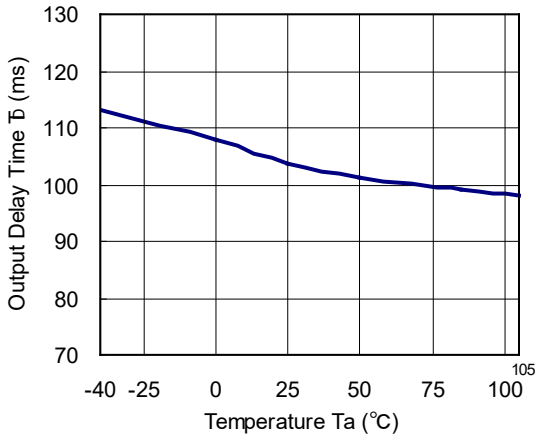


9) Output Delay Time vs. Temperature (C_D=22nF)

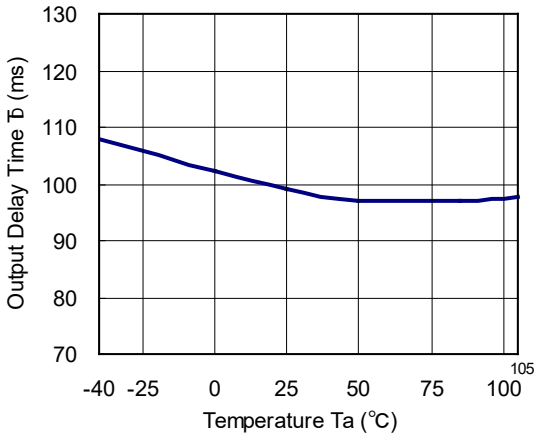
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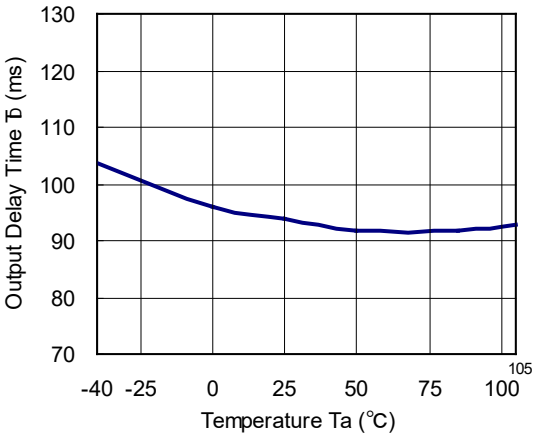
R3116x151A/C



R3116x271A/C



R3116x451A/C



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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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