RICOH

R3116x SERIES

0.8% LOW VOLTAGE DETECTOR WITH OUTPUT DELAY

NO.EA-161-080304

OUTLINE

The R3116x series are CMOS-based voltage detector ICs 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.

Each of these ICs 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.

The R3116x series are operable at a lower voltage than that of the R3112x series, and can be driven by a single battery.

Three types of packages, SOT-23-5, SC-82AB, and DFN(PLP)1010-4 are available.

FEATURES

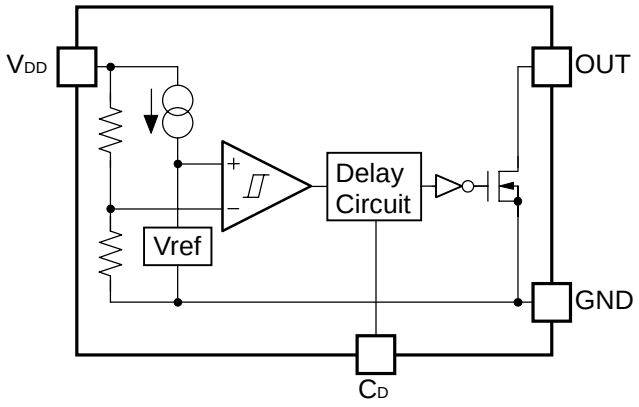
- Supply Current ..... Typ. 0.35μA ($-V_{DET}$=1.5V, V_{DD}=$-V_{DET}$+1V)
- Operating Voltage Range..... 0.5V to 6.0V (T_{opt}=25°C)
- Detector Threshold Range..... Stepwise setting with a step of 0.1V in the range of 0.7V to 5.0V
- Detector Threshold Accuracy..... ±0.8% ($-V_{DET} \geqq$ 1.5V)
- Temperature-Drift 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% ($-V_{DET} \geqq$ 1.5V)
- Output Types..... Nch Open Drain "L" and CMOS
- Packages ..... SOT-23-5, SC-82AB, DFN(PLP)1010-4

APPLICATIONS

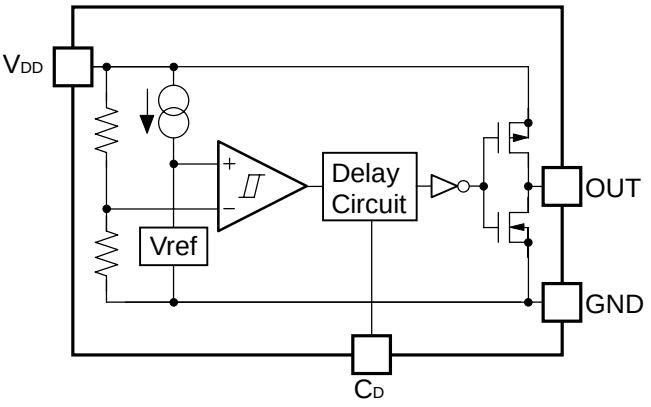
- CPU and Logic Circuit Reset
- Battery Checker
- Window Comparator
- Wave Shaping Circuit
- Battery Back-up Circuit
- Power Failure Detector

BLOCK DIAGRAMS

Nch Open Drain Output (R3116xxx1A)



CMOS Output (R3116xxx1C)



SELECTION GUIDE

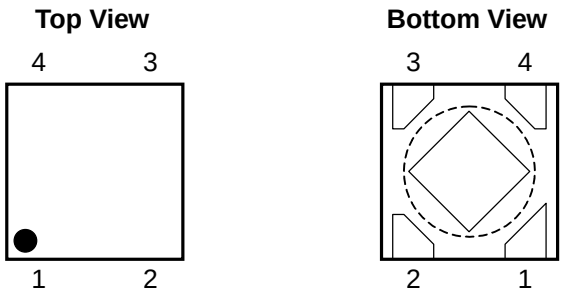
The package type, the detector threshold, the output type and the taping type for the ICs can be selected at the users' request. The selection can be made with designating the part number as shown below;

R3116xxx1x-xx-x ← Part Number
↑↑ ↑ ↑ ↑
a b c d e

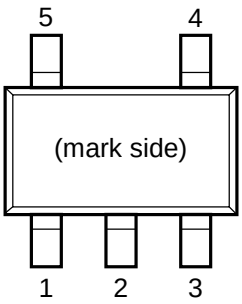
Code	Contents
a	Designation of Package Type; N: SOT-23-5 Q: SC-82AB K: DFN(PLP)1010-4
b	Setting Detector Threshold ($-V_{DET}$); Stepwise setting with a step of 0.1V in the range of 0.7V to 5.0V is possible.
c	Designation of Output Type; A: Nch Open Drain C: CMOS
d	Designation of Taping Type ; TR (Refer to Taping Specifications; TR type is the standard direction.)
e	Designation of Composition of pin plating -F : Lead free solder plating (SOT-23-5, SC-82AB) None: Au plating (DFN(PLP)1010-4)

PIN CONFIGURATIONS

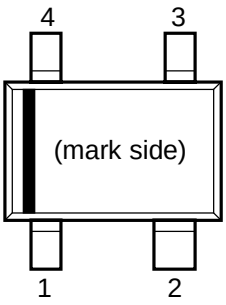
● **DFN(PLP)1010-4***



● **SOT-23-5**



● **SC-82AB**



PIN DESCRIPTIONS

● **DFN(PLP)1010-4***

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

∗) Tab in the ◌ parts have GND level.
(They are connected to the back side of this IC.)
Do not connect to other wires or land patterns.

● **SOT-23-5**

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

● **SC-82AB**

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

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 (SOT-23-5)*	420	mW
	Power Dissipation (SC-82AB)*	380	
	Power Dissipation (DFN(PLP)1010-4)*	400	
Topt	Operating Temperature Range	–40 to 85	°C
Tstg	Storage Temperature Range	–55 to 125	°C

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

ABSOLUTE MAXIMUM RATINGS

Absolute Maximum ratings are threshold limit values that must not be exceeded ever for an instant under any conditions. Moreover, such values for any two items must not be reached simultaneously. Operation above these absolute maximum ratings may cause degradation or permanent damage to the device. These are stress ratings only and do not necessarily imply functional operation below these limits.

ELECTRICAL CHARACTERISTICS

- **R3116x071A/C** □ values indicate −40°C ≦ Topt ≦ 85°C, unless otherwise noted. Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold	Topt=25°C		0.6880	0.7	0.7120	V
		−40°C ≦ Topt ≦ 85°C		0.6775		0.7225	
V_{HYS}	Detector Threshold Hysteresis			0.028		0.049	V
I_{SS}	Supply Current	V_{DD}=0.6V				1.4	μA
		V_{DD}=1.7V				1.2	
V_{DDH}	Maximum Operating Voltage					6	V
V_{DDL}	Minimum Operating Voltage*1	Topt=25°C				0.50	V
		−40°C ≦ Topt ≦ 85°C				0.55	
I_{OUT}	Output Current (Driver Output Pin)	Nch	V_{DD}=0.55V, V_{DS}=0.05V	7			μA
			V_{DD}=0.6V, V_{DS}=0.5V	0.02			mA
		Pch*2	V_{DD}=4.5V, V_{DS}=−2.1V	0.65			mA
I_{LEAK}	Nch Driver Leakage Current*3	V_{DD}=6.0V, V_{DS}=7.0V				80	nA
$\Delta-V_{DET}/\Delta Topt$	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C			±30		ppm /°C
t_D	Output Delay Time	C_D=0.022μF, V_{DD}=0.6V→0.77V	Topt=25°C	80	100	130	ms
			−40°C ≦ Topt ≦ 85°C	70		150	

- **R3116x151A/C** □ values indicate −40°C ≦ Topt ≦ 85°C, unless otherwise noted. Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold	Topt=25°C		1.4880	1.5	1.5120	V
		−40°C ≦ Topt ≦ 85°C		1.4775		1.5225	
V_{HYS}	Detector Threshold Hysteresis			0.060		0.105	V
I_{SS}	Supply Current	V_{DD}=1.4V				1.4	μA
		V_{DD}=2.5V			0.35	1.2	
V_{DDH}	Maximum Operating Voltage					6	V
V_{DDL}	Minimum Operating Voltage*1	Topt=25°C				0.50	V
		−40°C ≦ Topt ≦ 85°C				0.55	
I_{OUT}	Output Current (Driver Output Pin)	Nch	V_{DD}=0.55V, V_{DS}=0.05V	7			μA
			V_{DD}=1.0V, V_{DS}=0.5V	0.40			mA
		Pch*2	V_{DD}=4.5V, V_{DS}=−2.1V	0.65			mA
I_{LEAK}	Nch Driver Leakage Current*3	V_{DD}=6.0V, V_{DS}=7.0V				80	nA
$\Delta-V_{DET}/\Delta Topt$	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C			±30		ppm /°C
t_D	Output Delay Time	C_D=0.022μF, V_{DD}=1.4V→1.65V	Topt=25°C	85	100	115	ms
			−40°C ≦ Topt ≦ 85°C	75		135	

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

*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

● **R3116x271A/C** □ values indicate −40°C ≦ Topt ≦ 85°C, unless otherwise noted. Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold	Topt=25°C		2.6784	2.7	2.7216	V
		−40°C ≦ Topt ≦ 85°C		2.6595		2.7405	
V_{HYS}	Detector Threshold Hysteresis			0.108		0.189	V
I_{SS}	Supply Current	V_{DD}=2.6V				1.5	µA
		V_{DD}=3.7V				1.2	
V_{DDH}	Maximum Operating Voltage					6	V
V_{DDL}	Minimum Operating Voltage*1	Topt=25°C				0.50	V
		−40°C ≦ Topt ≦ 85°C				0.55	
I_{OUT}	Output Current (Driver Output Pin)	Nch	V_{DD}=0.55V, V_{DS}=0.05V	7			µA
			V_{DD}=1.5V, V_{DS}=0.5V	1.00			mA
		Pch*2	V_{DD}=4.5V, V_{DS}=−2.1V	0.65			mA
I_{LEAK}	Nch Driver Leakage Current*3	V_{DD}=6.0V, V_{DS}=7.0V				80	nA
$\Delta-V_{DET}/\Delta Topt$	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C			±30		ppm /°C
t_D	Output Delay Time	C_D=0.022µF, V_{DD}=2.6V→2.97V	Topt=25°C	85	100	115	ms
			−40°C ≦ Topt ≦ 85°C	75		135	

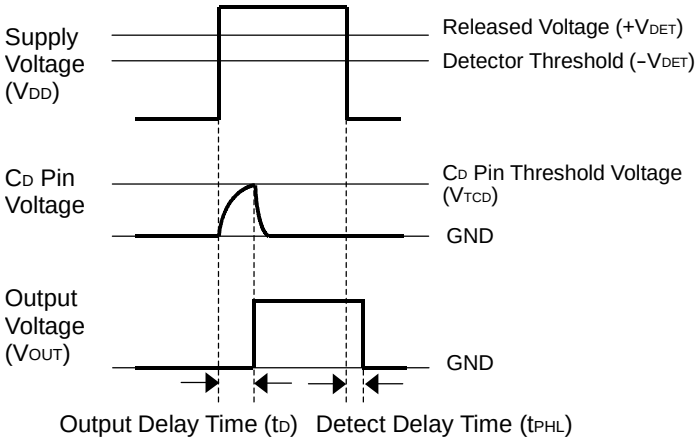
● **R3116x451A/C** □ values indicate −40°C ≦ Topt ≦ 85°C, unless otherwise noted. Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold	Topt=25°C		4.4640	4.5	4.5360	V
		−40°C ≦ Topt ≦ 85°C		4.4325		4.5675	
V_{HYS}	Detector Threshold Hysteresis			0.180		0.315	V
I_{SS}	Supply Current	V_{DD}=4.4V				1.7	µA
		V_{DD}=5.5V				1.4	
V_{DDH}	Maximum Operating Voltage					6	V
V_{DDL}	Minimum Operating Voltage*1	Topt=25°C				0.50	V
		−40°C ≦ Topt ≦ 85°C				0.55	
I_{OUT}	Output Current (Driver Output Pin)	Nch	V_{DD}=0.55V, V_{DS}=0.05V	7			µA
			V_{DD}=3.0V, V_{DS}=0.5V	2.40			mA
		Pch*2	V_{DD}=6.0V, V_{DS}=−2.1V	0.90			mA
I_{LEAK}	Nch Driver Leakage Current*3	V_{DD}=6.0V, V_{DS}=7.0V				80	nA
$\Delta-V_{DET}/\Delta Topt$	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C			±30		ppm /°C
t_D	Output Delay Time	C_D=0.022µF, V_{DD}=4.4V→4.95V	Topt=25°C	85	100	115	ms
			−40°C ≦ Topt ≦ 85°C	75		135	

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

*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**

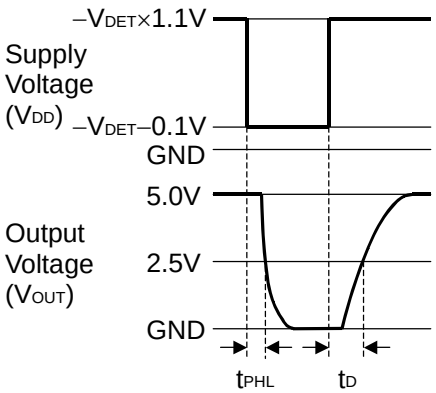
Output Delay Time (t_D) can be calculated with the next formula using the external capacitor:

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

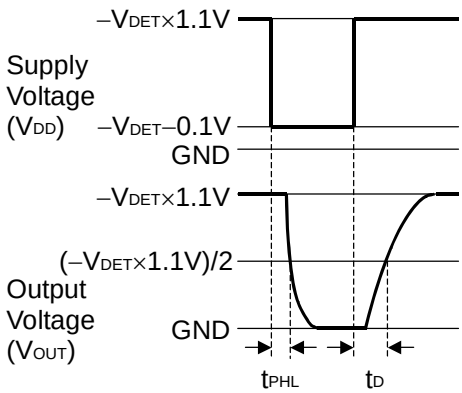
DEFINITION OF OUTPUT DELAY TIME

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 $(-V_{DET})\times 1.1V$ 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 $(-V_{DET})\times 1.1V$ pulse voltage is supplied, the becoming of the output voltage to $((-V_{DET})\times 1.1V)/2$.



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 −40°C ≦ Topt ≦ 85°C, unless otherwise noted.

Topt=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	0.6880	0.7120	**0.6775**	**0.7225**	**0.028**	**0.049**						
R3116x081A/C	0.7880	0.8120	**0.7775**	**0.8225**	**0.032**	**0.056**						
R3116x091A/C	0.8880	0.9120	**0.8775**	**0.9225**	**0.036**	**0.063**						
R3116x101A/C	0.9880	1.0120	**0.9775**	**1.0225**	**0.040**	**0.070**						
R3116x111A/C	1.0880	1.1120	**1.0775**	**1.1225**	**0.044**	**0.077**		**1.400**				
R3116x121A/C	1.1880	1.2120	**1.1775**	**1.2225**	**0.048**	**0.084**						
R3116x131A/C	1.2880	1.3120	**1.2775**	**1.3225**	**0.052**	**0.091**						
R3116x141A/C	1.3880	1.4120	**1.3775**	**1.4225**	**0.056**	**0.098**						
R3116x151A/C	1.4880	1.5120	**1.4775**	**1.5225**	**0.060**	**0.105**						
R3116x161A/C	1.5872	1.6128	**1.5760**	**1.6240**	**0.064**	**0.112**						
R3116x171A/C	1.6864	1.7136	**1.6745**	**1.7255**	**0.068**	**0.119**						
R3116x181A/C	1.7856	1.8144	**1.7730**	**1.8270**	**0.072**	**0.126**						
R3116x191A/C	1.8848	1.9152	**1.8715**	**1.9285**	**0.076**	**0.133**				**1.200**		
R3116x201A/C	1.9840	2.0160	**1.9700**	**2.0300**	**0.080**	**0.140**						
R3116x211A/C	2.0832	2.1168	**2.0685**	**2.1315**	**0.084**	**0.147**						
R3116x221A/C	2.1824	2.2176	**2.1670**	**2.2330**	**0.088**	**0.154**						
R3116x231A/C	2.2816	2.3184	**2.2655**	**2.3345**	**0.092**	**0.161**		**1.500**				
R3116x241A/C	2.3808	2.4192	**2.3640**	**2.4360**	**0.096**	**0.168**						
R3116x251A/C	2.4800	2.5200	**2.4625**	**2.5375**	**0.100**	**0.175**						0.50
R3116x261A/C	2.5792	2.6208	**2.5610**	**2.6390**	**0.104**	**0.182**						
R3116x271A/C	2.6784	2.7216	**2.6595**	**2.7405**	**0.108**	**0.189**	V_{DD}=		V_{DD}=			
R3116x281A/C	2.7776	2.8224	**2.7580**	**2.8420**	**0.112**	**0.196**	-V_{DET}		-V_{DET}		**6**	**0.55**
R3116x291A/C	2.8768	2.9232	**2.8565**	**2.9435**	**0.116**	**0.203**	-0.1V		+1.0V			
R3116x301A/C	2.9760	3.0240	**2.9550**	**3.0450**	**0.120**	**0.210**						
R3116x311A/C	3.0752	3.1248	**3.0535**	**3.1465**	**0.124**	**0.217**						∗Note1
R3116x321A/C	3.1744	3.2256	**3.1520**	**3.2480**	**0.128**	**0.224**						
R3116x331A/C	3.2736	3.3264	**3.2505**	**3.3495**	**0.132**	**0.231**						
R3116x341A/C	3.3728	3.4272	**3.3490**	**3.4510**	**0.136**	**0.238**						
R3116x351A/C	3.4720	3.5280	**3.4475**	**3.5525**	**0.140**	**0.245**		**1.600**		**1.300**		
R3116x361A/C	3.5712	3.6288	**3.5460**	**3.6540**	**0.144**	**0.252**						
R3116x371A/C	3.6704	3.7296	**3.6445**	**3.7555**	**0.148**	**0.259**						
R3116x381A/C	3.7696	3.8304	**3.7430**	**3.8570**	**0.152**	**0.266**						
R3116x391A/C	3.8688	3.9312	**3.8415**	**3.9585**	**0.156**	**0.273**						
R3116x401A/C	3.9680	4.0320	**3.9400**	**4.0600**	**0.160**	**0.280**						
R3116x411A/C	4.0672	4.1328	**4.0385**	**4.1615**	**0.164**	**0.287**						
R3116x421A/C	4.1664	4.2336	**4.1370**	**4.2630**	**0.168**	**0.294**						
R3116x431A/C	4.2656	4.3344	**4.2355**	**4.3645**	**0.172**	**0.301**						
R3116x441A/C	4.3648	4.4352	**4.3340**	**4.4660**	**0.176**	**0.308**						
R3116x451A/C	4.4640	4.5360	**4.4325**	**4.5675**	**0.180**	**0.315**		**1.700**		**1.400**		
R3116x461A/C	4.5632	4.6368	**4.5310**	**4.6690**	**0.184**	**0.322**						
R3116x471A/C	4.6624	4.7376	**4.6295**	**4.7705**	**0.188**	**0.329**						
R3116x481A/C	4.7616	4.8384	**4.7280**	**4.8720**	**0.192**	**0.336**						
R3116x491A/C	4.8608	4.9392	**4.8265**	**4.9735**	**0.196**	**0.343**						
R3116x501A/C	4.9600	5.0400	**4.9250**	**5.0750**	**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.

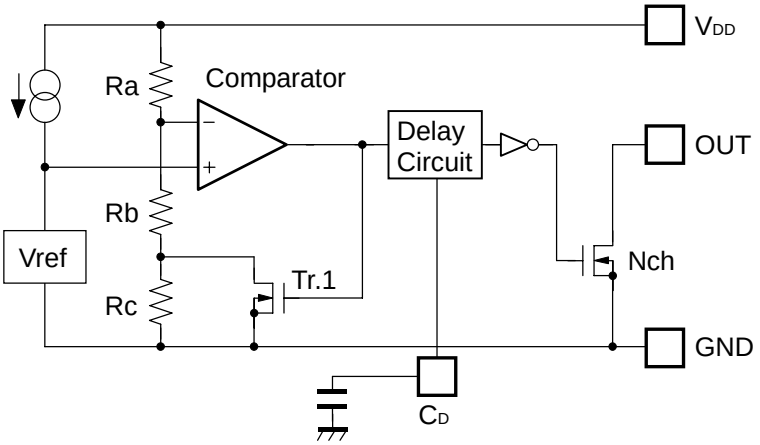
Nch Driver Output Current1		Nch Driver Output Current2		Pch Driver Output Current		Nch Driver Leakage Current		Detector Threshold Temperature Coefficient	Output Delay Time		
I_{OUT1} [µA]		I_{OUT2} [mA]		I_{OUT3} [mA]		I_{LEAK} [nA]		Δ-$V_{DET}/\Delta T_{opt}$ [ppm/°C]	t_D [ms]		
Cond.	Min.	Cond.	Min.	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**	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.

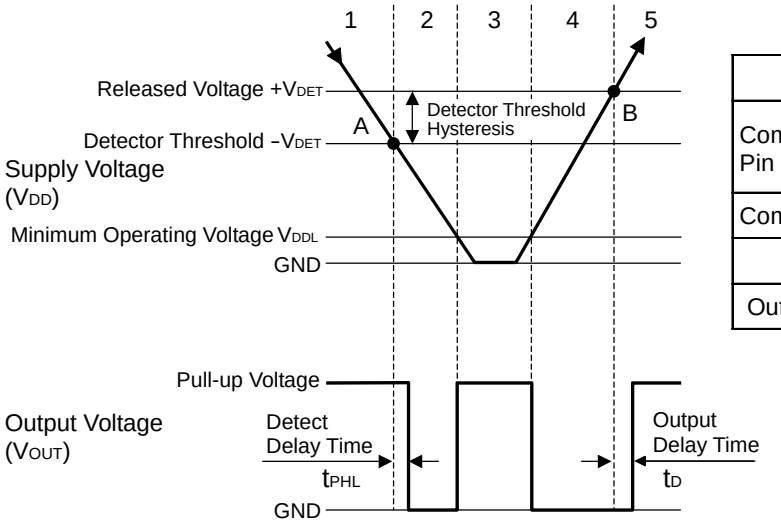
OPERATION

- **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 "H" to "L", therefore the output voltage becomes the GND level. The voltage level of Point A means a detector threshold voltage (−V_{DET}).

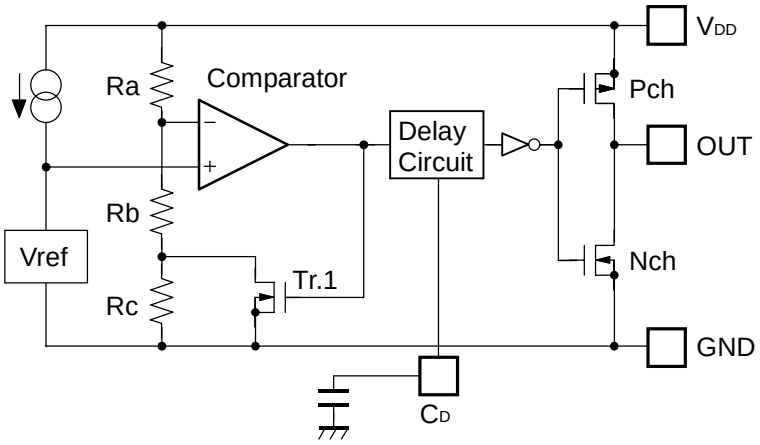
Step 3. When the supply voltage is lower than the minimum operating voltage, the operation of the output transistor becomes indefinite. The output voltage is equal to the pull-up voltage.

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

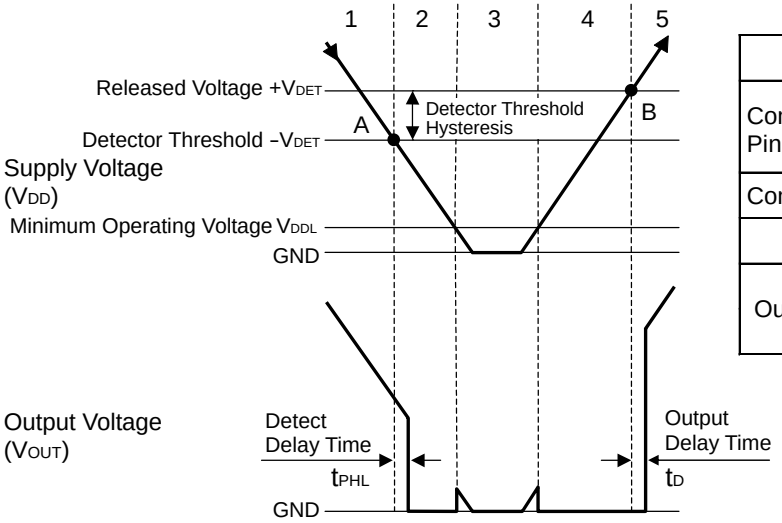
Step 5. At Point "B", Vref ≦ V_{DD}×Rb/(Ra+Rb) is true, as a result, the output of comparator is reversed from "L" to "H", then the output voltage is equal to the pull-up voltage. The voltage level of Point B means a released voltage (+V_{DET}).

∗) 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 "H" to "L", therefore the output voltage becomes the GND level. The voltage level of Point A means a detector threshold voltage ($-V_{DET}$).

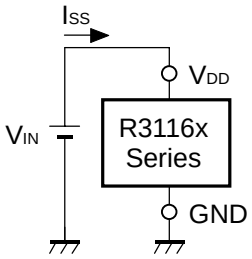
Step 3. When the supply voltage is lower than the minimum operating voltage, the operation of the output transistor becomes indefinite.

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

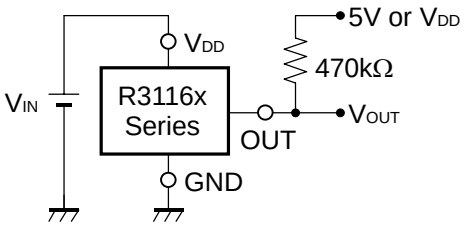
Step 5. At Point "B", Vref ≦ V_{DD}×Rb/(Ra+Rb) is true, as a result, the output of comparator is reversed from "L" to "H", then the output voltage is equal to the supply voltage (V_{DD}). The voltage level of Point B means a released voltage ($+V_{DET}$).

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

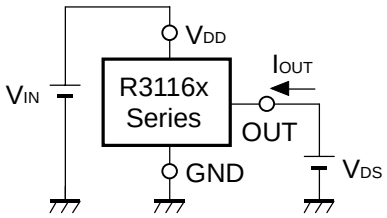
TEST CIRCUITS



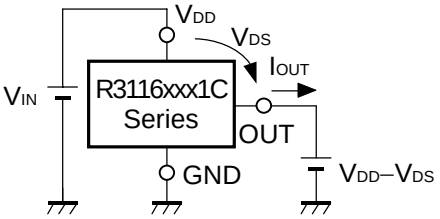
Supply Current Test Circuit



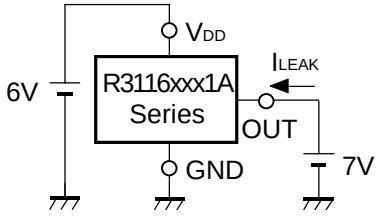
Detector Threshold Test Circuit
(Pull-up circuit is not necessary for CMOS Output type.)



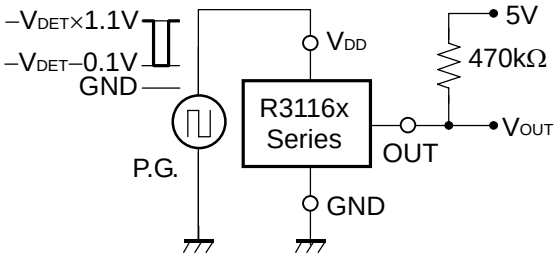
Nch Driver Output Current Test Circuit



Pch Driver Output Current Test Circuit
∗Apply to CMOS Output type only



Nch Driver Leakage Current Test Circuit
∗Apply to Nch Driver Output type only

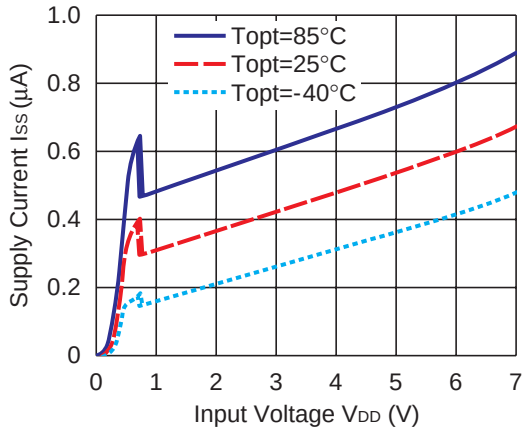


Output Delay Time Test Circuit
(Pull-up circuit is not necessary for CMOS Output type.)

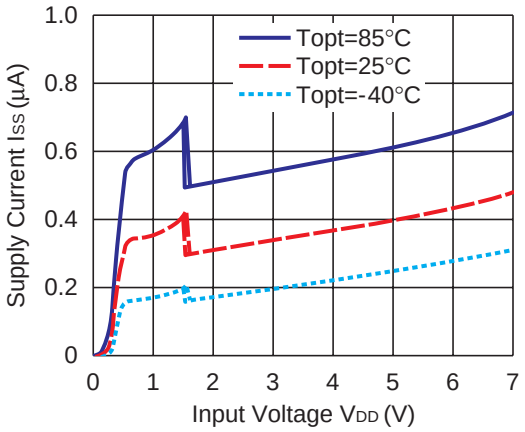
TYPICAL CHARACTERISTICS

1) Supply Current vs. Input Voltage

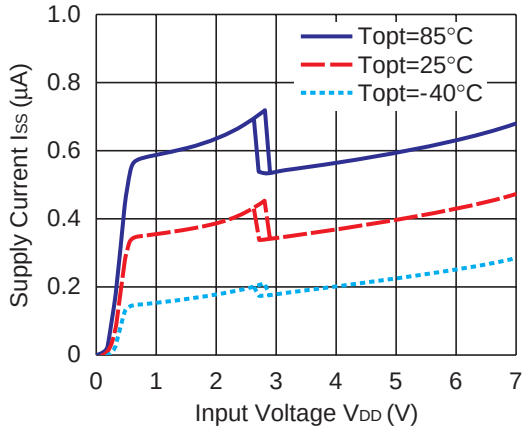
R3116x071A/C



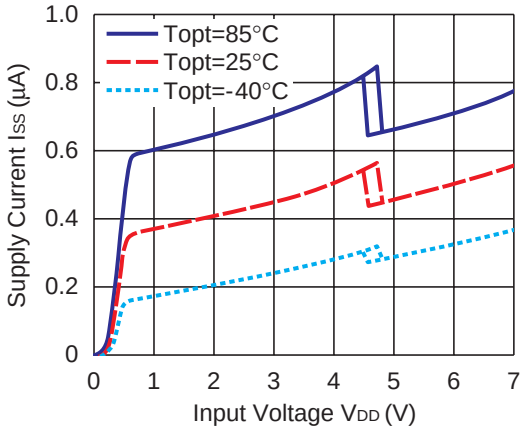
R3116x151A/C



R3116x271A/C

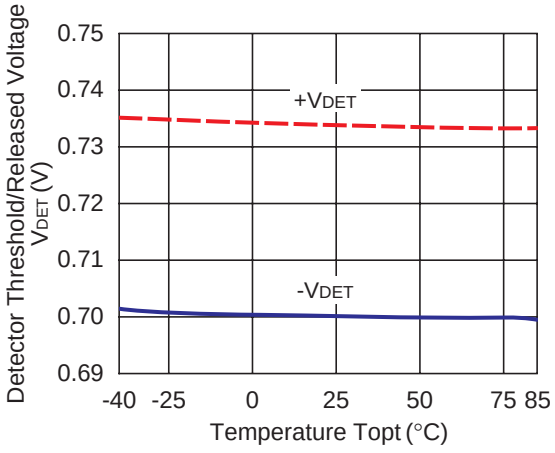


R3116x451A/C

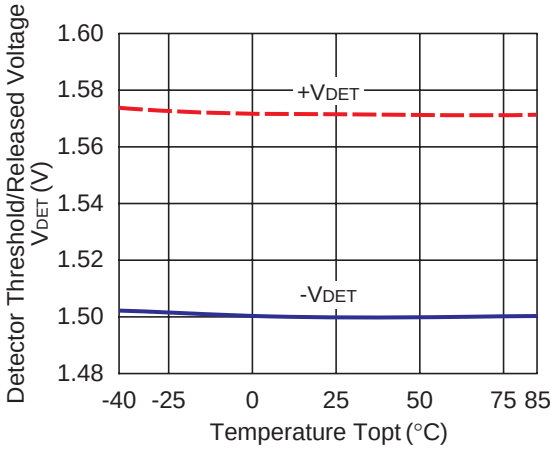


2) Detector Threshold vs. Temperature

R3116x071A/C



R3116x151A/C



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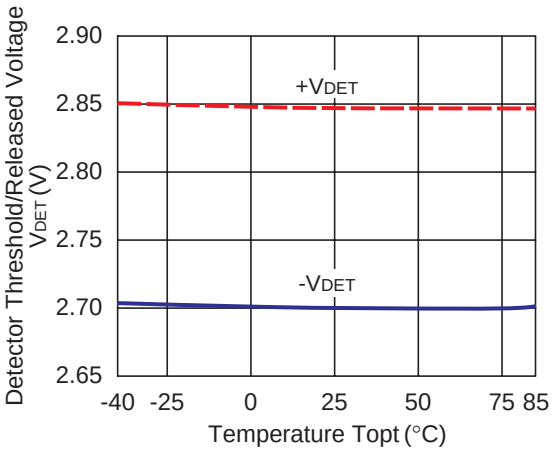

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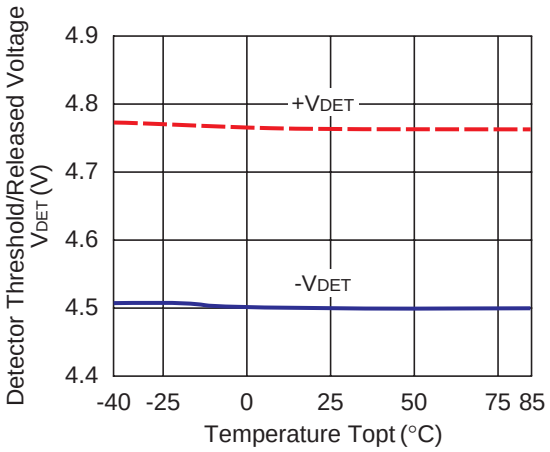
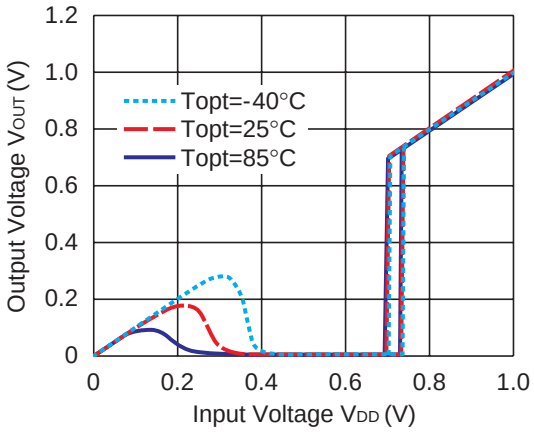


3) Output Voltage vs. Input Voltage

R3116x071C



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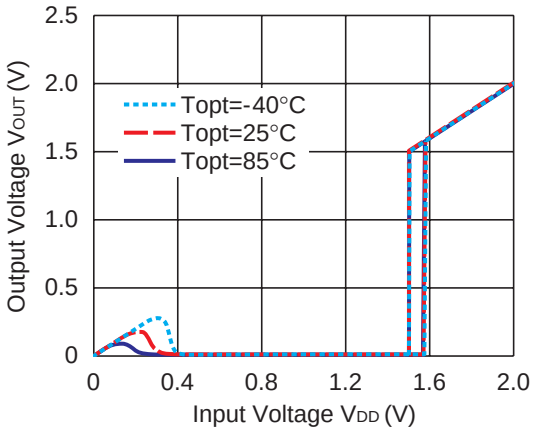
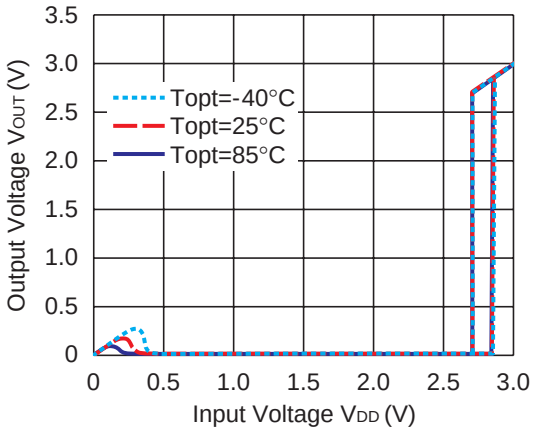


R3116x271C



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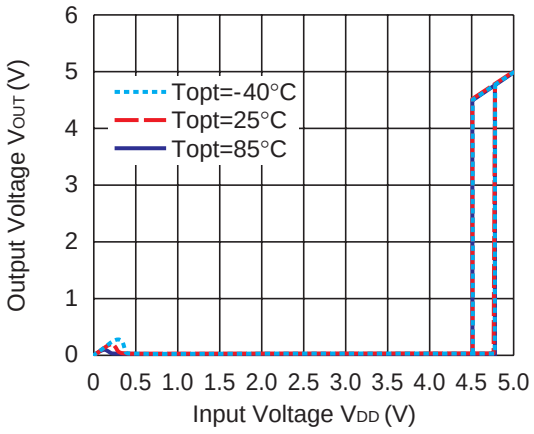

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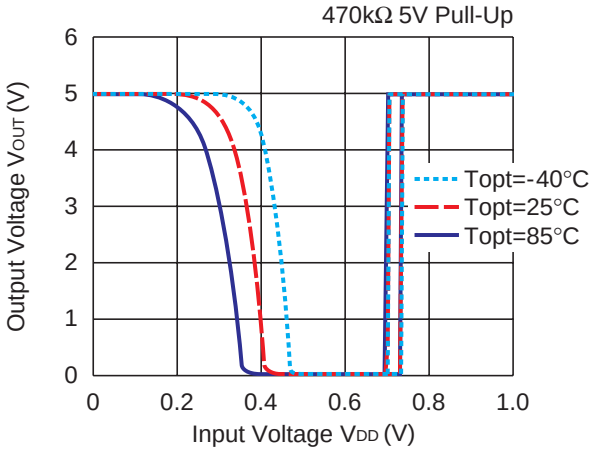

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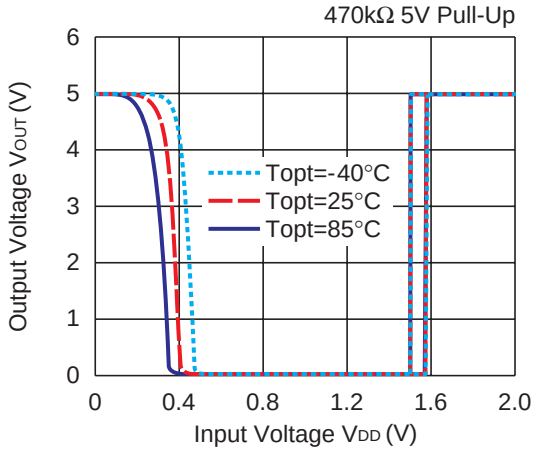

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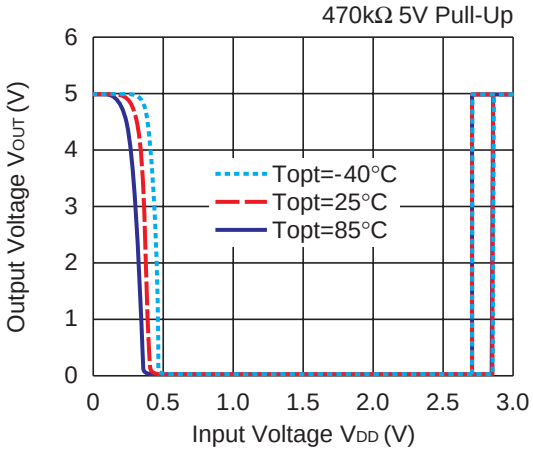

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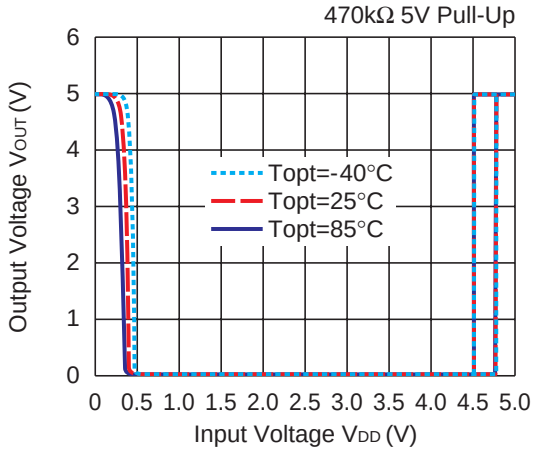
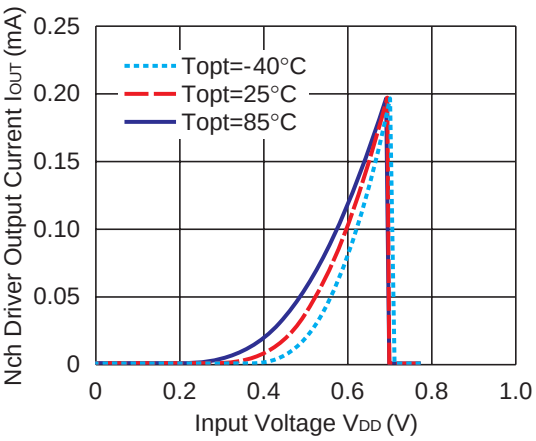
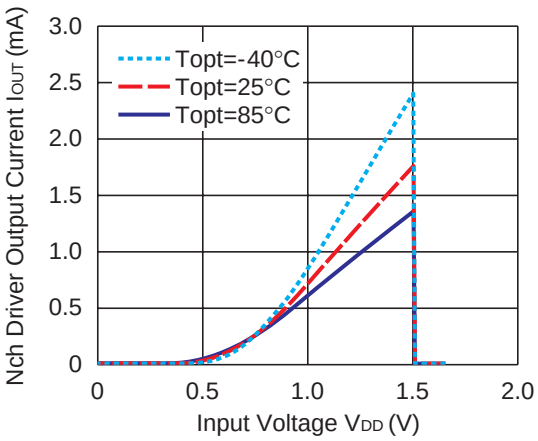


4) Nch Driver Output Current vs. Input Voltage (V_{DS}=0.5V)

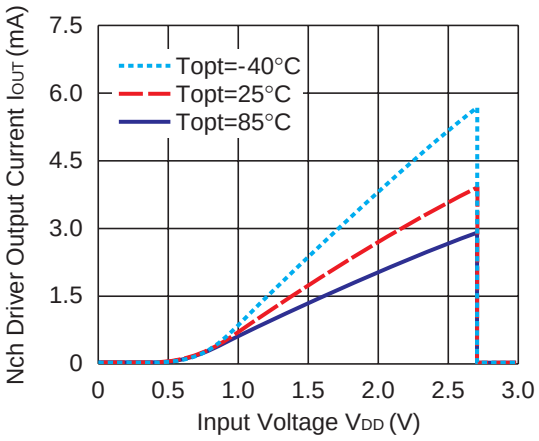
R3116x071A/C



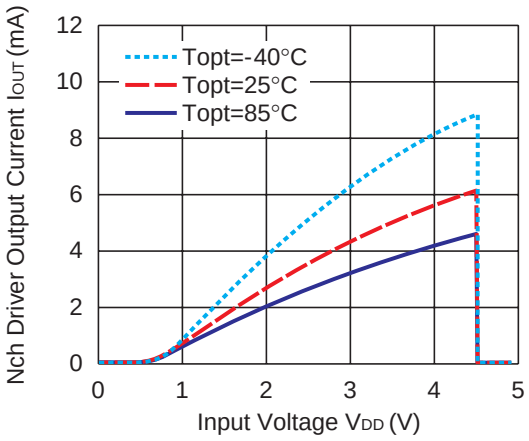
R3116x151A/C



R3116x271A/C

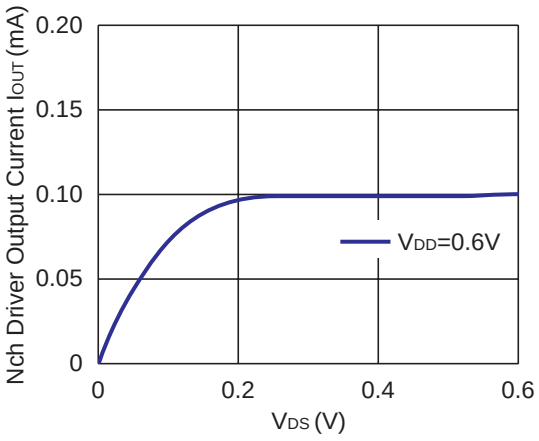


R3116x451A/C

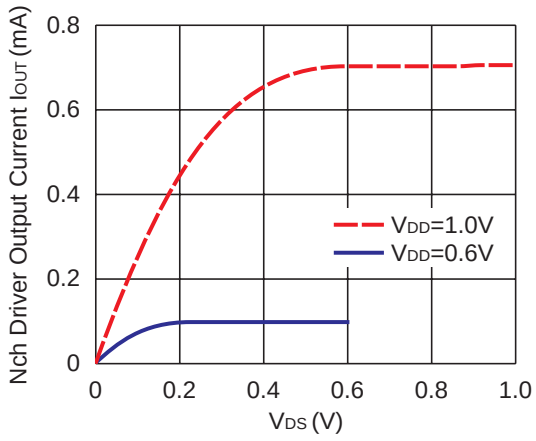


5) Nch Driver Output Current vs. V_{DS}

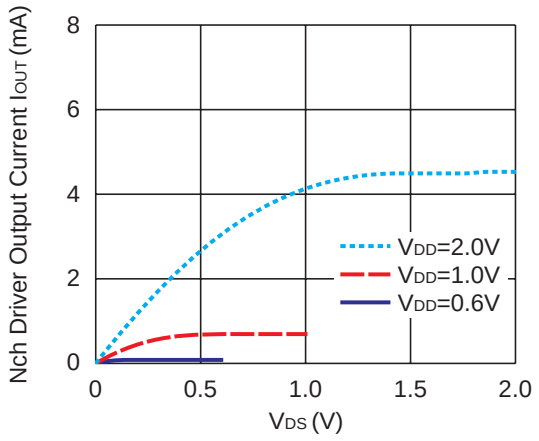
R3116x071A/C



R3116x151A/C



R3116x271A/C



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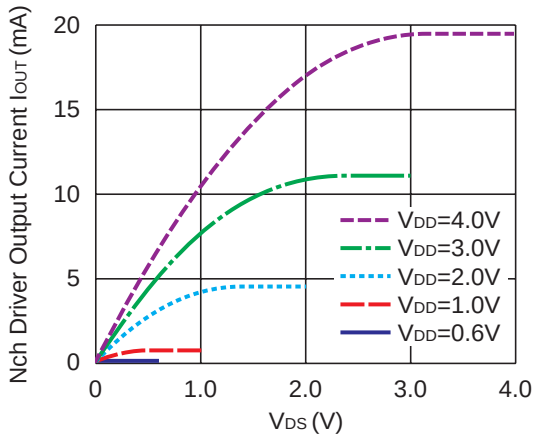
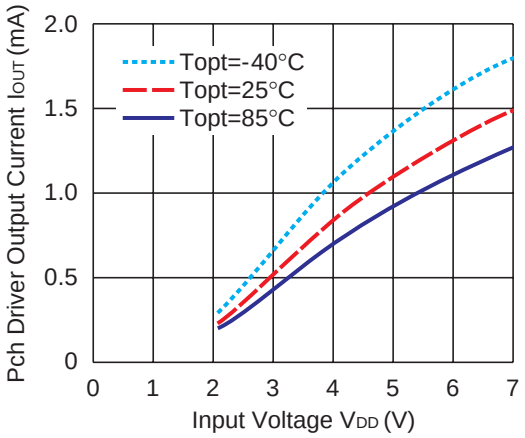
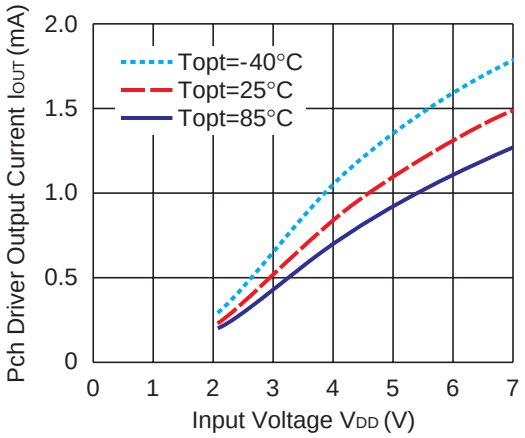


6) Pch Driver Output Current vs. Input Voltage (V_{DS}=–2.1V)

R3116x071C



R3116x151C



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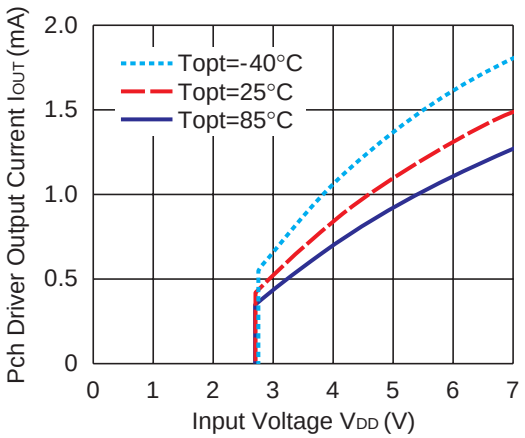

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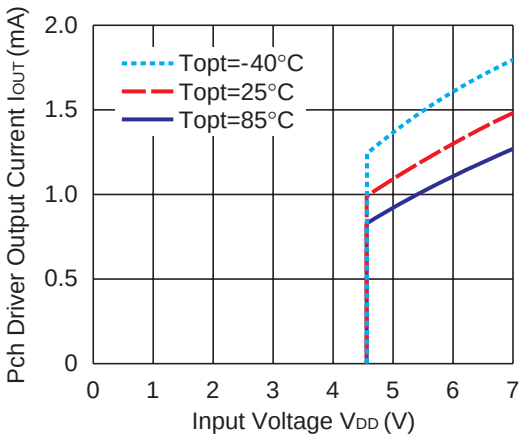
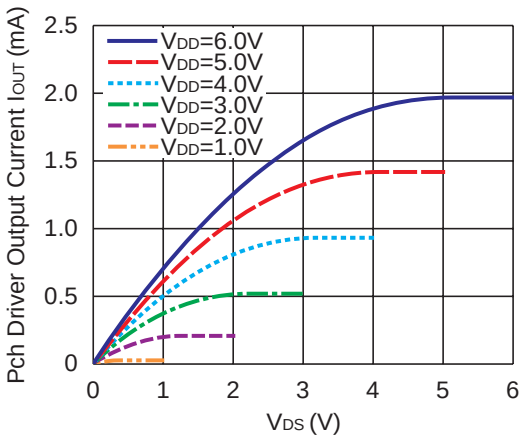
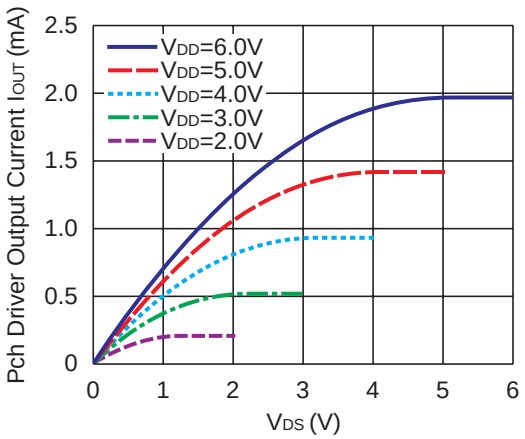


7) Pch Driver Output Current vs. V_{DS}

R3116x071C



R3116x151C



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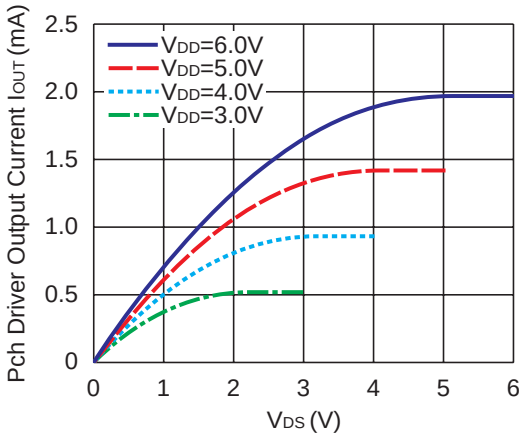

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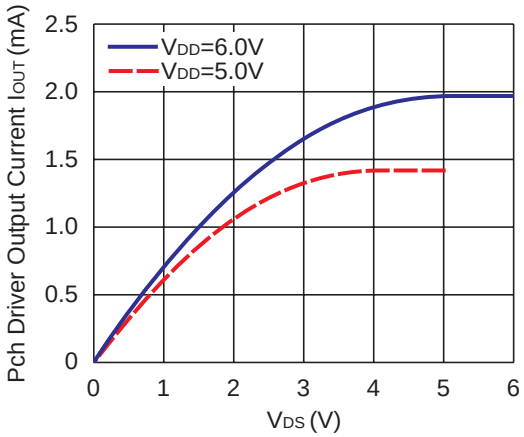
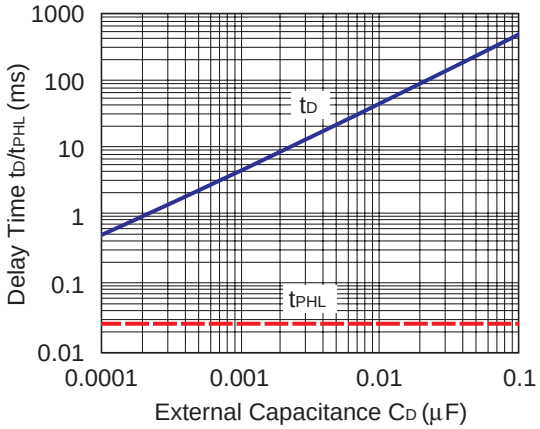
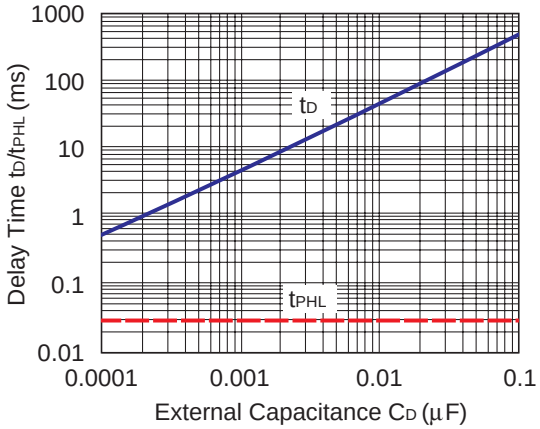


8) Output Delay Time vs. External Capacitance

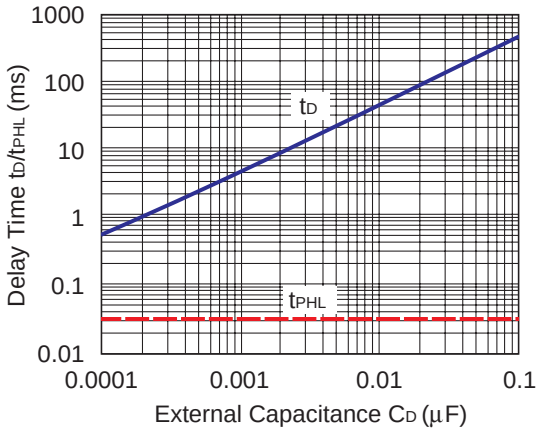
R3116x071A/C



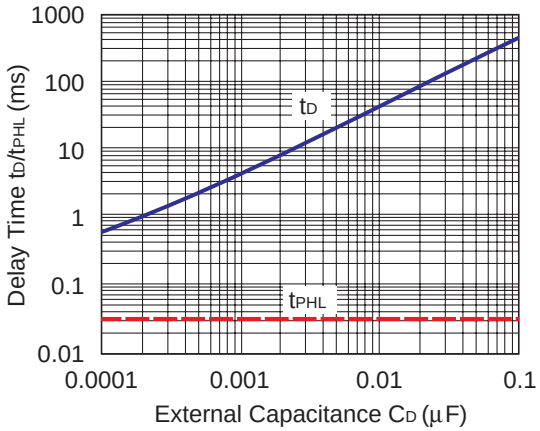
R3116x151A/C



R3116x271A/C

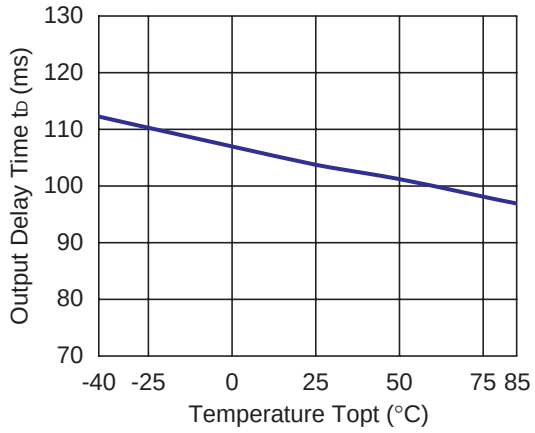


R3116x451A/C

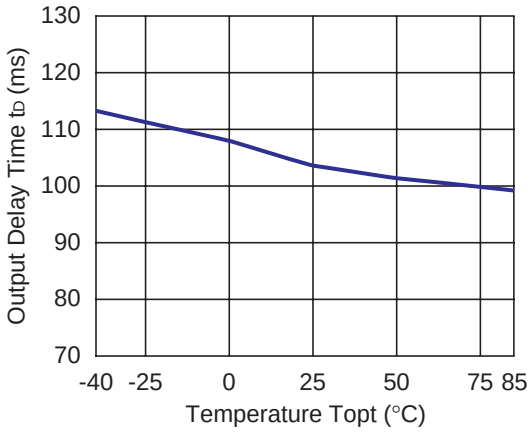


9) Output Delay Time vs. Temperature (C_D=22nF)

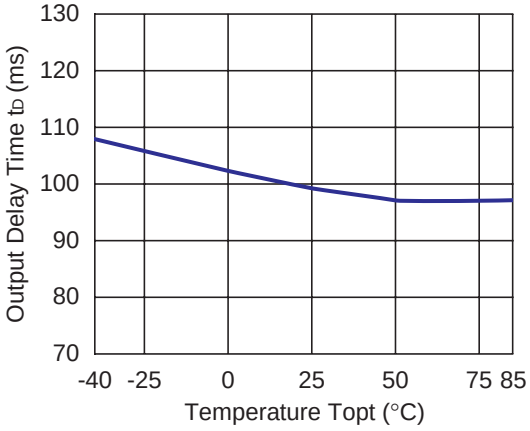
R3116x071A/C



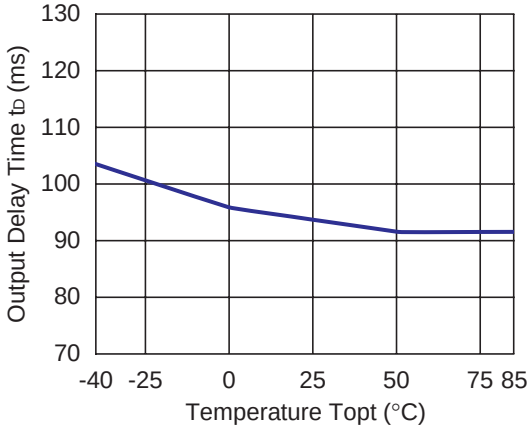
R3116x151A/C



R3116x271A/C



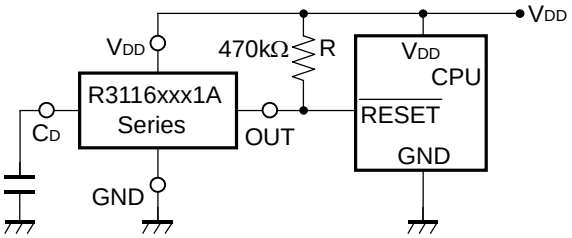
R3116x451A/C



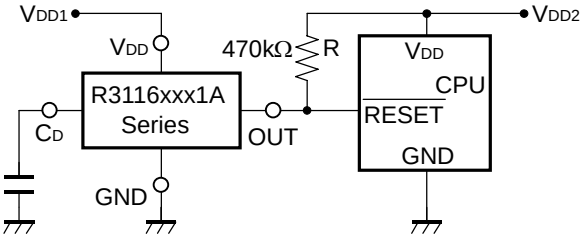
TYPICAL APPLICATION

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

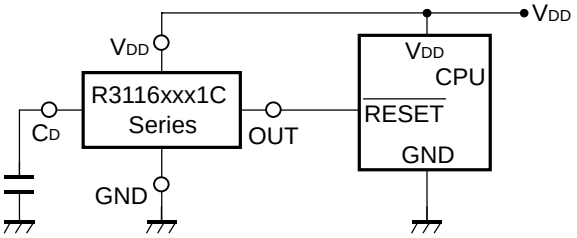
Case1. Input Voltage to R3116xxx1A is equal to Input Voltage to CPU



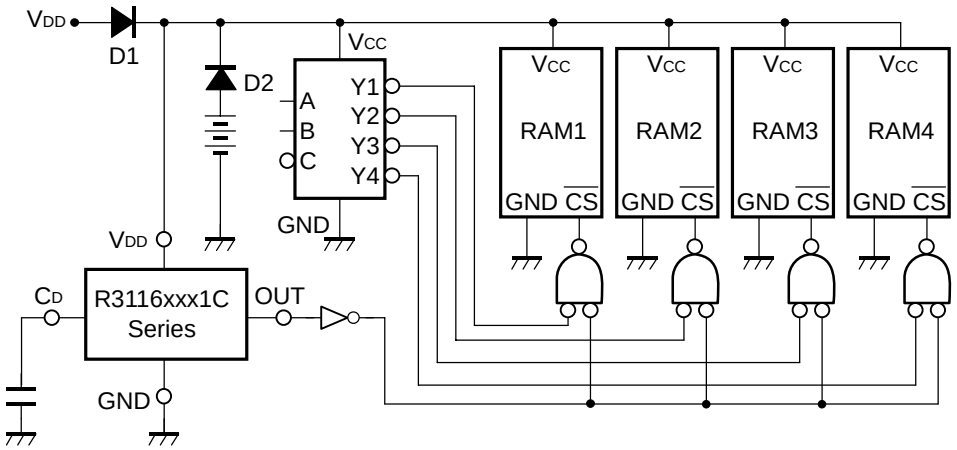
Case2. Input Voltage to R3116xxx1A is unequal to Input Voltage to CPU



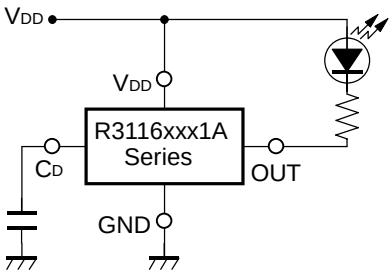
- **R3116xxx1C CPU Reset Circuit 2 (CMOS Output)**



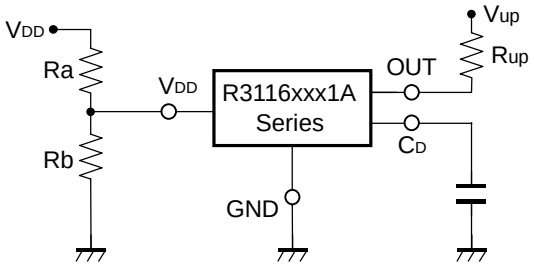
- **Memory Back-up Circuit**



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



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

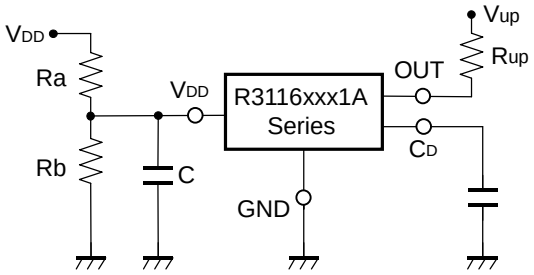


Adjustable Detector Threshold=$(-V_{DET})\times(Ra+Rb)/Rb$

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 VDD are connected, the voltage dropdown caused by Rup, may cause difference in the hysteresis voltage.

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

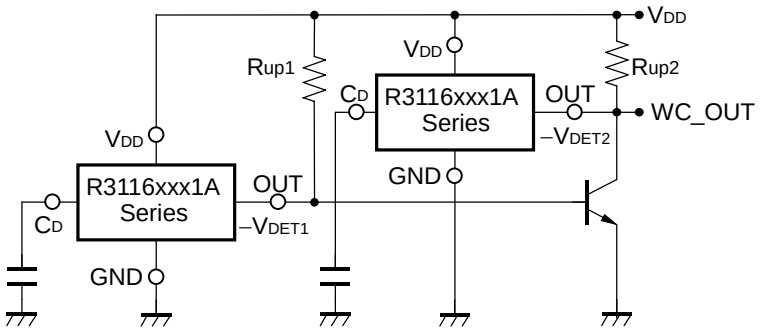


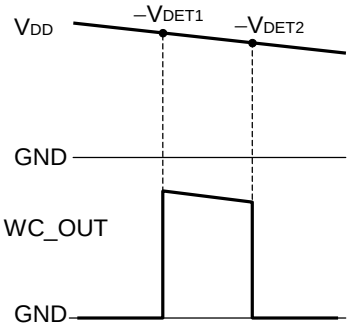
Adjustable Detector Threshold=$(-V_{DET})\times(Ra+Rb)/Rb$

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

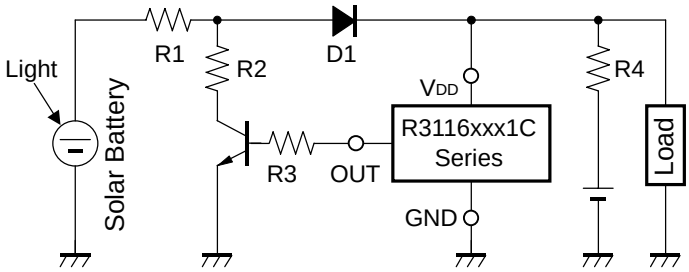
∗1) To prevent oscillation, set Ra ≦ 100kΩ, C ≧ 0.01μF.
∗2) If the value of Ra is set excessively large, voltage drop may occur caused by the supply current of IC itself, and detector threshold and hysteresis voltage may vary.
∗3) If Vup and VDD are connected, the voltage dropdown caused by Rup, may 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 R3116xxx1A/C is used in Figure 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 R3116xxx1A/C is used in Figure Y, if the value of R1 is set excessively large, the dropdown voltage caused by the consumption current of IC itself, may vary the detecor 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 R3116xxx1A/C is used in Figure Z, 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 R2 is set small, released voltage level may shift and the minimum operating voltage may differ. If the value of R2 is set excessively small from R1, release may not occur and may cause oscillation.

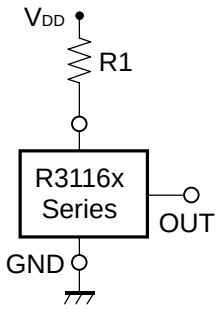


Figure X

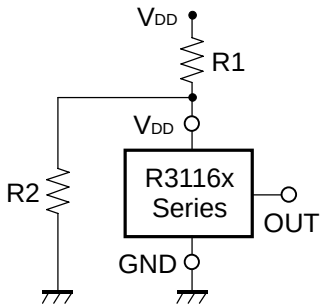


Figure Y

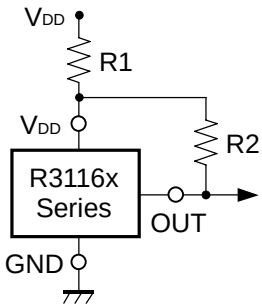
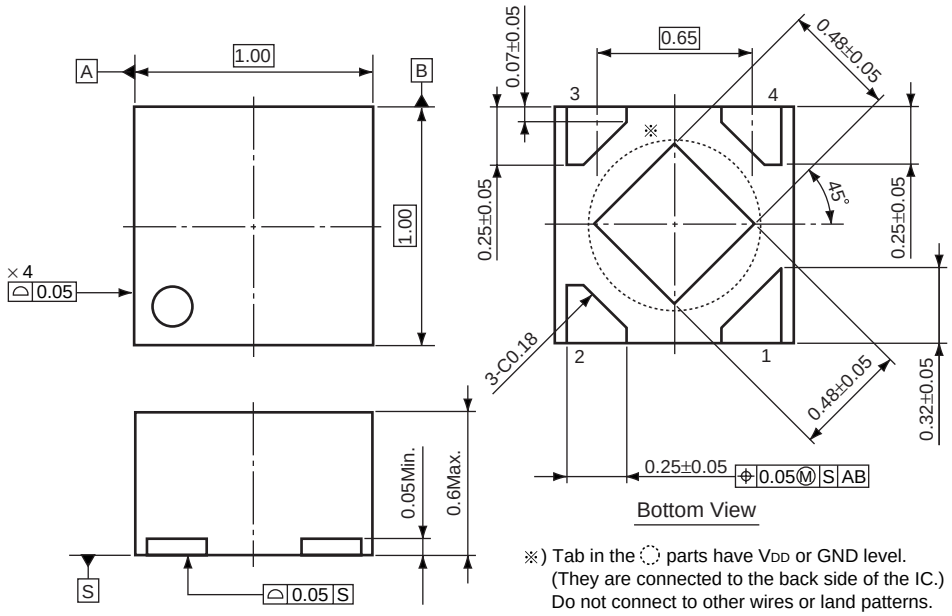


Figure Z

- **DFN(PLP)1010-4**

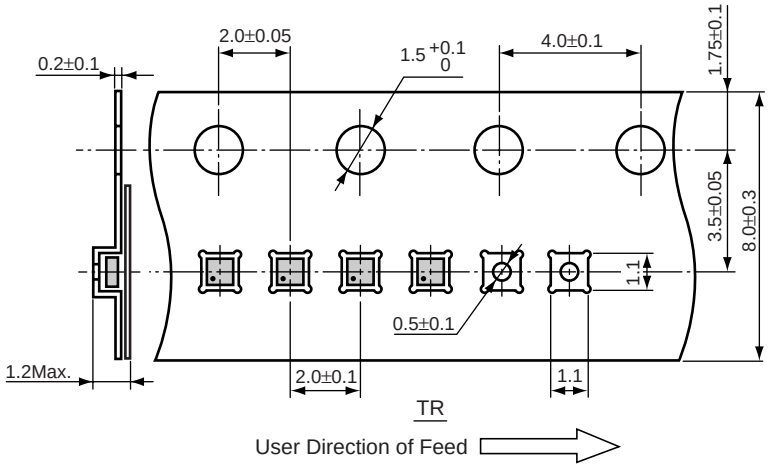
Unit: mm

PACKAGE DIMENSIONS



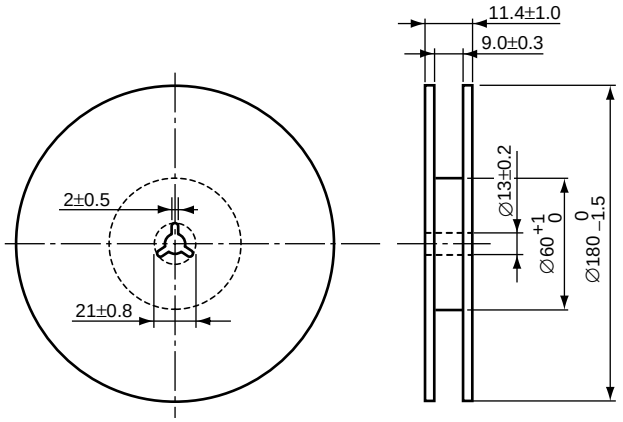
※) Tab in the ◌ parts have V_{DD} or GND level.
(They are connected to the back side of the IC.)
Do not connect to other wires or land patterns.

TAPING SPECIFICATION



TAPING REEL DIMENSIONS REUSE REEL (EIAJ-RRM-08Bc)

(1reel=10000pcs)



POWER DISSIPATION (DFN(PLP)1010-4)

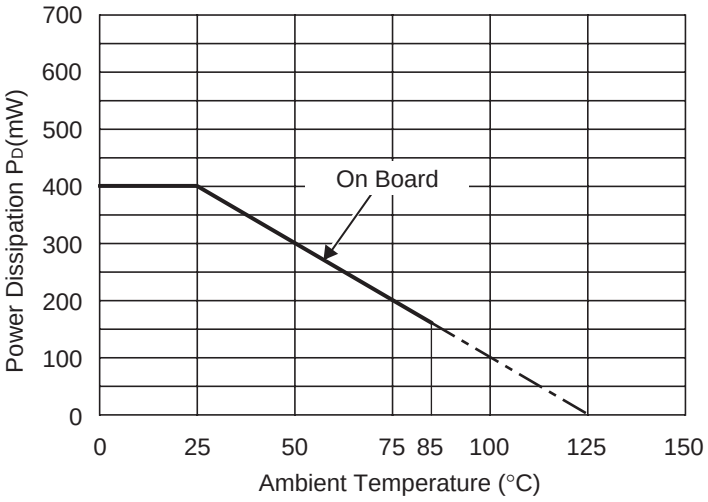
This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

Measurement Conditions

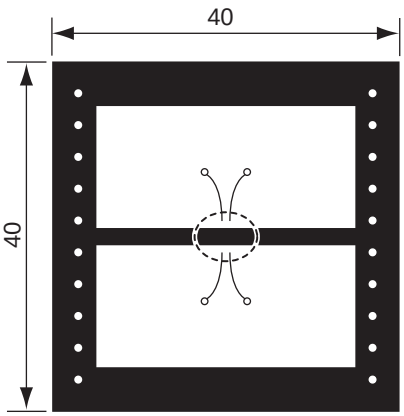
	Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Top side : Approx. 50% , Back side : Approx. 50%
Through-hole	ϕ0.54mm × 24pcs

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

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



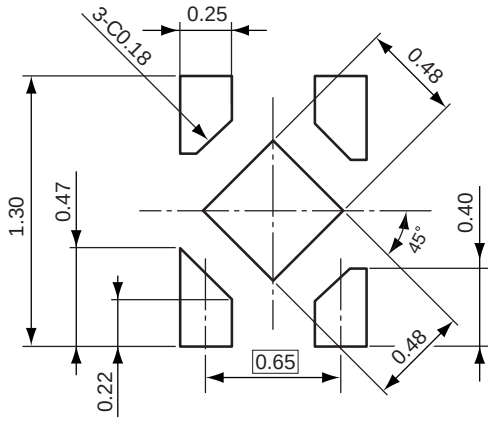
Power Dissipation



Measurement Board Pattern

IC Mount Area (Unit : mm)

RECOMMENDED LAND PATTERN

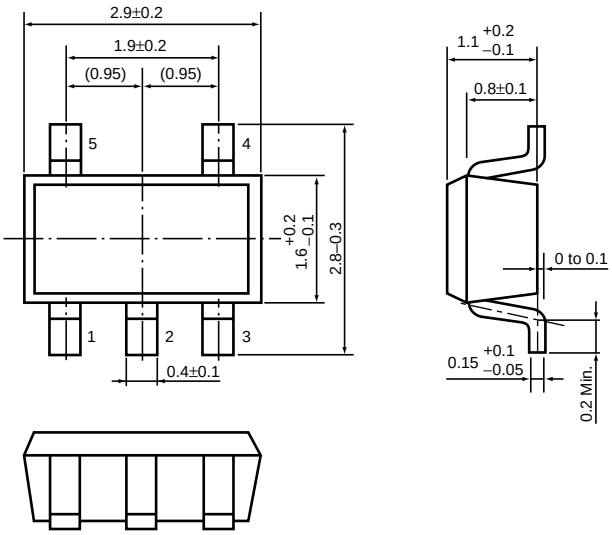


(Unit: mm)

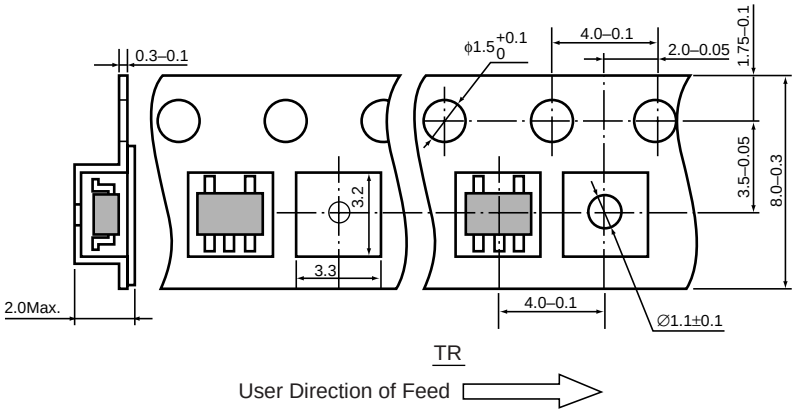
- **SOT-23-5 (SC-74A)**

Unit: mm

PACKAGE DIMENSIONS

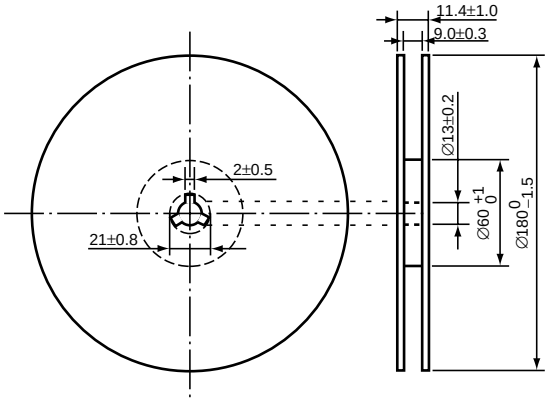


TAPING SPECIFICATION



TAPING REEL DIMENSIONS REUSE REEL (EIAJ-RRM-08Bc)

(1reel=3000pcs)



POWER DISSIPATION (SOT-23-5)

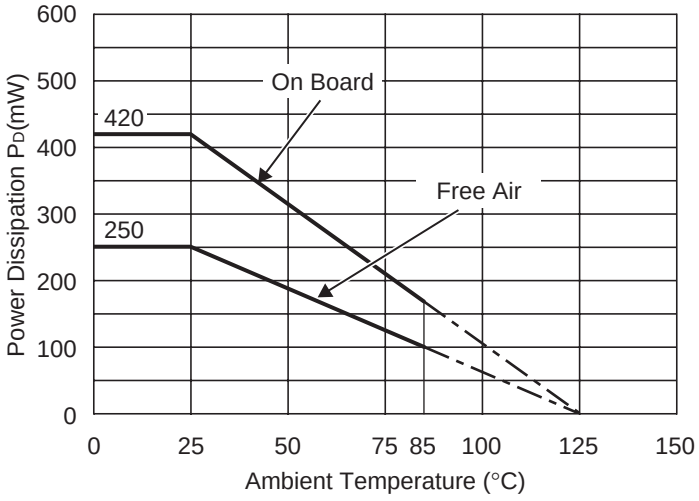
This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:
(Power Dissipation (SOT-23-5) is substitution of SOT-23-6.)

Measurement Conditions

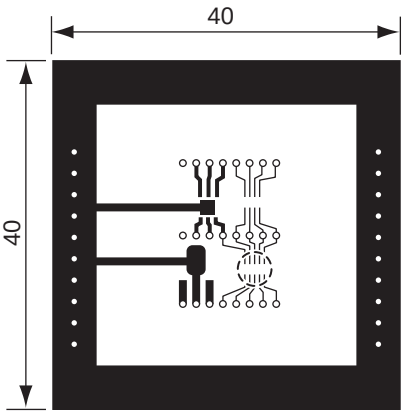
	Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Top side : Approx. 50% , Back side : Approx. 50%
Through-hole	ϕ0.5mm × 44pcs

Measurement Result (Topt=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



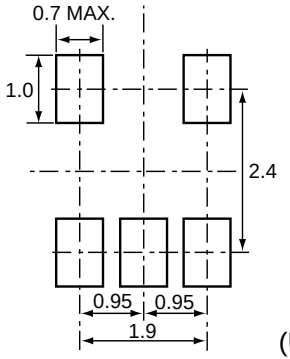
Power Dissipation



Measurement Board Pattern

IC Mount Area Unit : mm

RECOMMENDED LAND PATTERN

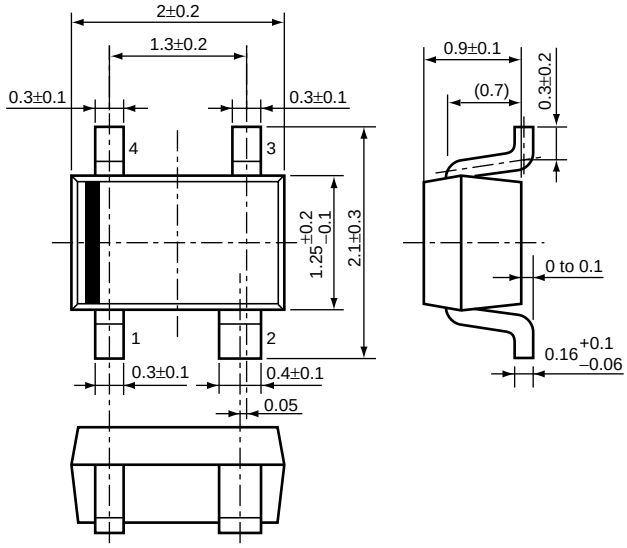


(Unit: mm)

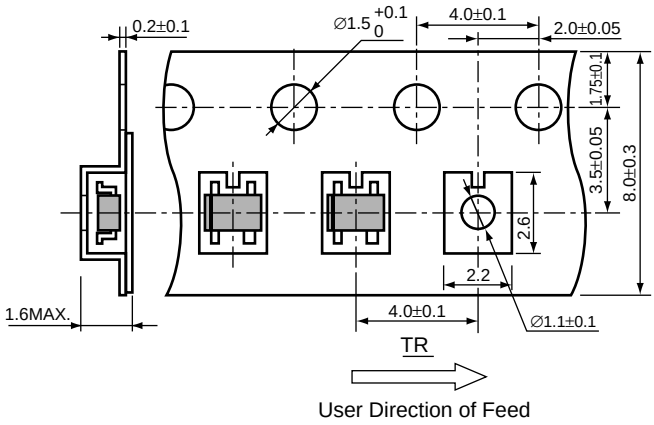
- **SC-82AB**

Unit: mm

PACKAGE DIMENSIONS

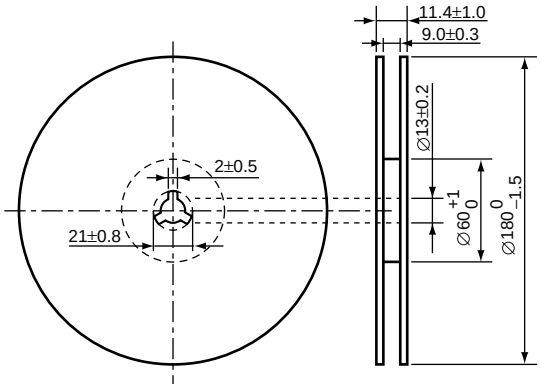


TAPING SPECIFICATION



TAPING REEL DIMENSIONS

(1reel=3000pcs)



POWER DISSIPATION (SC-82AB)

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:

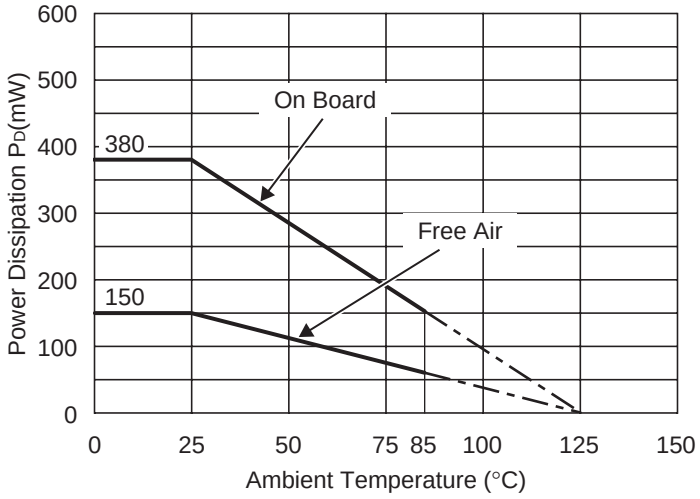
Measurement Conditions

	Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plactic (Double sided)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Top side : Approx. 50% , Back side : Approx. 50%
Through-hole	ϕ0.5mm × 44pcs

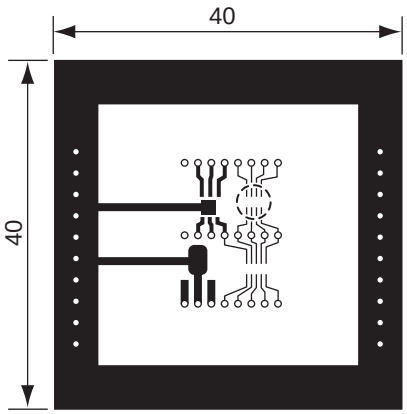
Measurement Result

(Topt=25°C,Tjmax=125°C)

	Standard Land Pattern	Free Air
Power Dissipation	380mW	150mW
Thermal Resistance	θja=(125−25°C)/0.38W=263°C/W	667°C/W



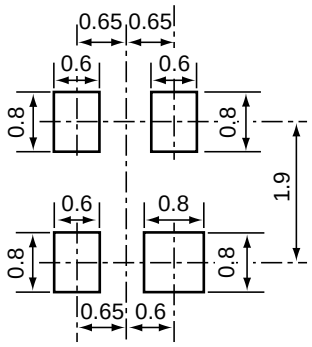
Power Dissipation



Measurement Board Pattern

IC Mount Area (Unit : mm)

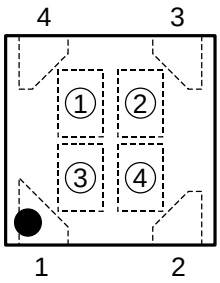
RECOMMENDED LAND PATTERN



(Unit: mm)

R3116K SERIES MARK SPECIFICATION

- **DFN(PLP)1010-4**



①, ② : Product Code (refer to Part Number vs. Product Code)

③, ④ : Lot Number

- **Part Number vs. Product Code**

Part Number	Product Code	
	①	②
R3116K071A	H	A
R3116K081A	H	B
R3116K091A	H	C
R3116K101A	H	D
R3116K111A	H	E
R3116K121A	H	F
R3116K131A	H	G
R3116K141A	H	H
R3116K151A	H	J
R3116K161A	H	K
R3116K171A	H	L
R3116K181A	H	M
R3116K191A	H	N
R3116K201A	H	P
R3116K211A	H	Q
R3116K221A	H	R
R3116K231A	H	S
R3116K241A	H	T
R3116K251A	H	U
R3116K261A	H	V
R3116K271A	H	W
R3116K281A	H	X
R3116K291A	H	Y
R3116K301A	H	Z

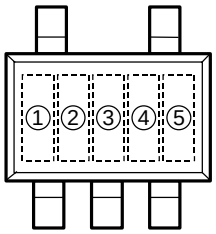
Part Number	Product Code	
	①	②
R3116K311A	J	A
R3116K321A	J	B
R3116K331A	J	C
R3116K341A	J	D
R3116K351A	J	E
R3116K361A	J	F
R3116K371A	J	G
R3116K381A	J	H
R3116K391A	J	J
R3116K401A	J	K
R3116K411A	J	L
R3116K421A	J	M
R3116K431A	J	N
R3116K441A	J	P
R3116K451A	J	Q
R3116K461A	J	R
R3116K471A	J	S
R3116K481A	J	T
R3116K491A	J	U
R3116K501A	J	V

Part Number	Product Code	
	①	②
R3116K071C	K	A
R3116K081C	K	B
R3116K091C	K	C
R3116K101C	K	D
R3116K111C	K	E
R3116K121C	K	F
R3116K131C	K	G
R3116K141C	K	H
R3116K151C	K	J
R3116K161C	K	K
R3116K171C	K	L
R3116K181C	K	M
R3116K191C	K	N
R3116K201C	K	P
R3116K211C	K	Q
R3116K221C	K	R
R3116K231C	K	S
R3116K241C	K	T
R3116K251C	K	U
R3116K261C	K	V
R3116K271C	K	W
R3116K281C	K	X
R3116K291C	K	Y
R3116K301C	K	Z

Part Number	Product Code	
	①	②
R3116K311C	L	A
R3116K321C	L	B
R3116K331C	L	C
R3116K341C	L	D
R3116K351C	L	E
R3116K361C	L	F
R3116K371C	L	G
R3116K381C	L	H
R3116K391C	L	J
R3116K401C	L	K
R3116K411C	L	L
R3116K421C	L	M
R3116K431C	L	N
R3116K441C	L	P
R3116K451C	L	Q
R3116K461C	L	R
R3116K471C	L	S
R3116K481C	L	T
R3116K491C	L	U
R3116K501C	L	V

R3116N SERIES MARK SPECIFICATION

- **SOT-23-5 (SC-74A)**



① to ③ : Product Code (refer to Part Number vs. Product Code)

④, ⑤ : Lot Number

- **Part Number vs. Product Code**

Part Number	Product Code		
	①	②	③
R3116N071A	D	0	A
R3116N081A	D	0	B
R3116N091A	D	0	C
R3116N101A	D	0	D
R3116N111A	D	0	E
R3116N121A	D	0	F
R3116N131A	D	0	G
R3116N141A	D	0	H
R3116N151A	D	0	J
R3116N161A	D	0	K
R3116N171A	D	0	L
R3116N181A	D	0	M
R3116N191A	D	0	N
R3116N201A	D	0	P
R3116N211A	D	0	Q
R3116N221A	D	0	R
R3116N231A	D	0	S
R3116N241A	D	0	T
R3116N251A	D	0	U
R3116N261A	D	0	V
R3116N271A	D	0	W
R3116N281A	D	0	X
R3116N291A	D	0	Y
R3116N301A	D	0	Z

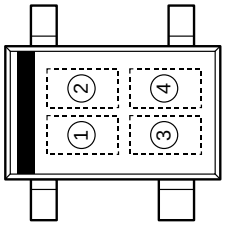
Part Number	Product Code		
	①	②	③
R3116N311A	E	0	A
R3116N321A	E	0	B
R3116N331A	E	0	C
R3116N341A	E	0	D
R3116N351A	E	0	E
R3116N361A	E	0	F
R3116N371A	E	0	G
R3116N381A	E	0	H
R3116N391A	E	0	J
R3116N401A	E	0	K
R3116N411A	E	0	L
R3116N421A	E	0	M
R3116N431A	E	0	N
R3116N441A	E	0	P
R3116N451A	E	0	Q
R3116N461A	E	0	R
R3116N471A	E	0	S
R3116N481A	E	0	T
R3116N491A	E	0	U
R3116N501A	E	0	V

Part Number	Product Code		
	①	②	③
R3116N071C	D	1	A
R3116N081C	D	1	B
R3116N091C	D	1	C
R3116N101C	D	1	D
R3116N111C	D	1	E
R3116N121C	D	1	F
R3116N131C	D	1	G
R3116N141C	D	1	H
R3116N151C	D	1	J
R3116N161C	D	1	K
R3116N171C	D	1	L
R3116N181C	D	1	M
R3116N191C	D	1	N
R3116N201C	D	1	P
R3116N211C	D	1	Q
R3116N221C	D	1	R
R3116N231C	D	1	S
R3116N241C	D	1	T
R3116N251C	D	1	U
R3116N261C	D	1	V
R3116N271C	D	1	W
R3116N281C	D	1	X
R3116N291C	D	1	Y
R3116N301C	D	1	Z

Part Number	Product Code		
	①	②	③
R3116N311C	E	1	A
R3116N321C	E	1	B
R3116N331C	E	1	C
R3116N341C	E	1	D
R3116N351C	E	1	E
R3116N361C	E	1	F
R3116N371C	E	1	G
R3116N381C	E	1	H
R3116N391C	E	1	J
R3116N401C	E	1	K
R3116N411C	E	1	L
R3116N421C	E	1	M
R3116N431C	E	1	N
R3116N441C	E	1	P
R3116N451C	E	1	Q
R3116N461C	E	1	R
R3116N471C	E	1	S
R3116N481C	E	1	T
R3116N491C	E	1	U
R3116N501C	E	1	V

R3116Q SERIES MARK SPECIFICATION

- **SC-82AB**



①, ② : Product Code (refer to Part Number vs. Product Code)

③, ④ : Lot Number

- **Part Number vs. Product Code**

Part Number	Product Code	
	①	②
R3116Q071A	L	0
R3116Q081A	L	1
R3116Q091A	L	2
R3116Q101A	L	3
R3116Q111A	L	4
R3116Q121A	L	5
R3116Q131A	L	6
R3116Q141A	L	7
R3116Q151A	L	8
R3116Q161A	L	9
R3116Q171A	M	0
R3116Q181A	M	1
R3116Q191A	M	2
R3116Q201A	M	3
R3116Q211A	M	4
R3116Q221A	M	5
R3116Q231A	M	6
R3116Q241A	M	7
R3116Q251A	M	8
R3116Q261A	M	9
R3116Q271A	N	0
R3116Q281A	N	1
R3116Q291A	N	2
R3116Q301A	N	3

Part Number	Product Code	
	①	②
R3116Q311A	N	4
R3116Q321A	N	5
R3116Q331A	N	6
R3116Q341A	N	7
R3116Q351A	N	8
R3116Q361A	N	9
R3116Q371A	P	0
R3116Q381A	P	1
R3116Q391A	P	2
R3116Q401A	P	3
R3116Q411A	P	4
R3116Q421A	P	5
R3116Q431A	P	6
R3116Q441A	P	7
R3116Q451A	P	8
R3116Q461A	P	9
R3116Q471A	Q	0
R3116Q481A	Q	1
R3116Q491A	Q	2
R3116Q501A	Q	3

Part Number	Product Code	
	①	②
R3116Q071C	R	0
R3116Q081C	R	1
R3116Q091C	R	2
R3116Q101C	R	3
R3116Q111C	R	4
R3116Q121C	R	5
R3116Q131C	R	6
R3116Q141C	R	7
R3116Q151C	R	8
R3116Q161C	R	9
R3116Q171C	S	0
R3116Q181C	S	1
R3116Q191C	S	2
R3116Q201C	S	3
R3116Q211C	S	4
R3116Q221C	S	5
R3116Q231C	S	6
R3116Q241C	S	7
R3116Q251C	S	8
R3116Q261C	S	9
R3116Q271C	T	0
R3116Q281C	T	1
R3116Q291C	T	2
R3116Q301C	T	3

Part Number	Product Code	
	①	②
R3116Q311C	T	4
R3116Q321C	T	5
R3116Q331C	T	6
R3116Q341C	T	7
R3116Q351C	T	8
R3116Q361C	T	9
R3116Q371C	U	0
R3116Q381C	U	1
R3116Q391C	U	2
R3116Q401C	U	3
R3116Q411C	U	4
R3116Q421C	U	5
R3116Q431C	U	6
R3116Q441C	U	7
R3116Q451C	U	8
R3116Q461C	U	9
R3116Q471C	V	0
R3116Q481C	V	1
R3116Q491C	V	2
R3116Q501C	V	3