# 0.8% Low Voltage Detector with Output Delay

NO.EA-161-140819

## 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

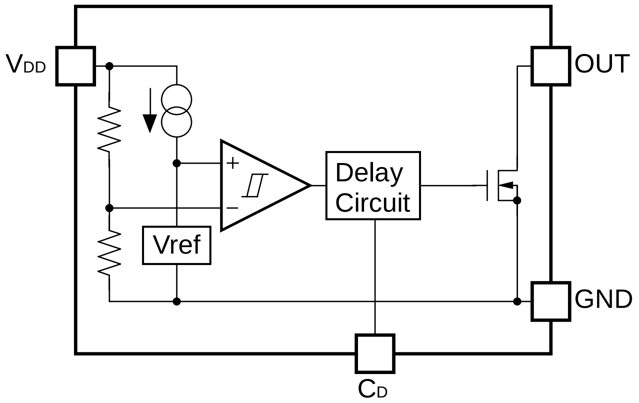
- Supply Current .......................................................... Typ. 0.35µA ($-V_{DET}$=1.5V, $V_{DD}$=$-V_{DET}$+1V)
- Operating Voltage Range ............................................ 0.5V to 6.0V ($T_{opt}$=25°C)
- Detector Threshold Range .......................................... 0.7V to 5.0V (0.1V step)
- 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 "L" and CMOS
- Packages ................................................................... DFN(PLP)1010-4, SC-82AB, SOT-23-5

## APPLICATIONS

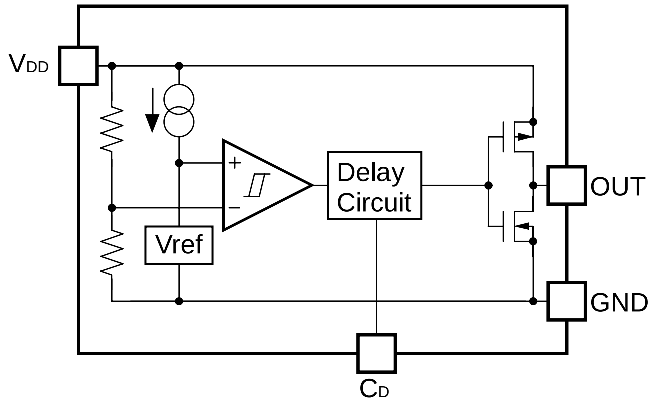
- CPU and Logic Circuit Reset
- Battery Checker
- Window Comparator
- Wave Shaping Circuit
- Battery Back-up Circuit
- Power Failure Detector

# 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.

| Product Name | Package | Quantity per Reel | Pb Free | Halogen Free |
|---|---|---|---|---|
| R3116Kxx1∗-TR | DFN(PLP)1010-4 | 10,000 pcs | Yes | Yes |
| R3116Qxx1∗-TR-FE | SC-82AB | 3,000 pcs | Yes | Yes |
| R3116Nxx1∗-TR-FE | SOT-23-5 | 3,000 pcs | Yes | Yes |

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

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



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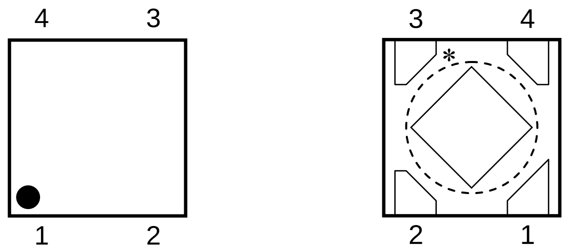
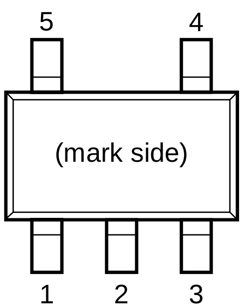
# PIN DESCRIPTIONS

● **DFN(PLP)1010-4**

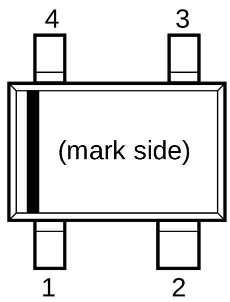
**Top View** **Bottom View**




● **SOT-23-5**




● **SC-82AB**




## ● DFN(PLP)1010-4

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

*) Tab is GND level. (They are connected to the reverse side of this IC.)
The tab is better to be connected to the GND, but leaving it open is also acceptable.

## ● SOT-23-5

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

# 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 |

* 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 is not assured.

**RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)**

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

# ELECTRICAL CHARACTERISTICS

- **R3116xxx1A/C** ☐ values indicate –40°C ≤ Topt ≤ 85°C, unless otherwise noted. (Topt=25°C)

| Symbol | Item | Conditions | | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|---|
| -VDET | Detector Threshold | Topt=25°C | 1.5V < -VDET ≤ 5.0V | | -VDET × 0.992 | | -VDET ×1.008 | V |
| | | | 0.7V ≤ -VDET ≤ 1.5V | | -12 | | +12 | mV |
| | | –40°C ≤ Topt ≤ 85°C | 1.5V < -VDET ≤ 5.0V | | -VDET × 0.985 | | -VDET × 1.015 | V |
| | | | 0.7V ≤ -VDET ≤ 1.5V | | -22.5 | | +22.5 | mV |
| VHYS | Detector Threshold Hysteresis | | | | -VDET × 0.04 | | -VDET × 0.07 | V |
| ISS | Supply Current | VDD=-VDET –0.1V | 0.7V ≤ -VDET < 1.6V | | | | 1.400 | μA |
| | | | 1.6V ≤ -VDET < 3.1V | | | | 1.500 | |
| | | | 3.1V ≤ -VDET < 4.1V | | | | 1.600 | |
| | | | 4.1V ≤ -VDET ≤ 5.0V | | | | 1.700 | |
| | | VDD=-VDET +1.0V | 0.7V ≤ -VDET < 1.6V | | | | 1.200 | |
| | | | 1.6V ≤ -VDET < 3.1V | | | | 1.200 | |
| | | | 3.1V ≤ -VDET < 4.1V | | | | 1.300 | |
| | | | 4.1V ≤ -VDET ≤ 5.0V | | | | 1.400 | |
| VDDH | Maximum Operating Voltage | | | | | | 6 | V |
| VDDL | Minimum Operating Voltage*1 | Topt=25°C | | | | | 0.50 | V |
| | | –40°C ≤ Topt ≤ 85°C | | | | | 0.55 | |
| IOUT | Output Current (Driver Output Pin) | Nch | VDD=0.55V, VDS=0.05V | | 7 | | | μA |
| | | | 0.7V ≤ -VDET < 1.1V | VDD=0.6V, VDS=0.5V | 0.020 | | | mA |
| | | | 1.1V ≤ -VDET < 1.6V | VDD=1.0V, VDS=0.5V | 0.400 | | | |
| | | | 1.6V ≤ -VDET < 3.1V | VDD=1.5V, VDS=0.5V | 1.000 | | | |
| | | | 3.1V ≤ -VDET ≤ 5.0V | VDD=3.0V, VDS=0.5V | 2.400 | | | |
| | | Pch*2 | 0.7V ≤ -VDET < 4.0V | VDD=4.5V, VDS=–2.1V | 0.650 | | | mA |
| | | | 4.0V ≤ -VDET ≤ 5.0V | VDD=6.0V, VDS=–2.1V | 0.900 | | | |
| ILEAK | Nch Driver Leakage Current*3 | VDD=6.0V, VDS=7.0V | | | | | 80 | nA |
| Δ-VDET/ΔTopt | Detector Threshold Temperature Coefficient | | | | | ±30 | | ppm/°C |
| tD | Output Delay Time | CD=0.022μF VDD=-VDET–0.1V to -VDET × 1.1V | Topt=25°C | 0.7V ≤ -VDET < 1.5V | 80 | 100 | 130 | ms |
| | | | | 1.5V ≤ -VDET ≤ 5.0V | 85 | | 115 | |
| | | | –40°C ≤ Topt ≤ 85°C | 0.7V ≤ -VDET < 1.5V | 70 | 100 | 150 | |
| | | | | 1.5V ≤ -VDET ≤ 5.0V | 75 | | 135 | |

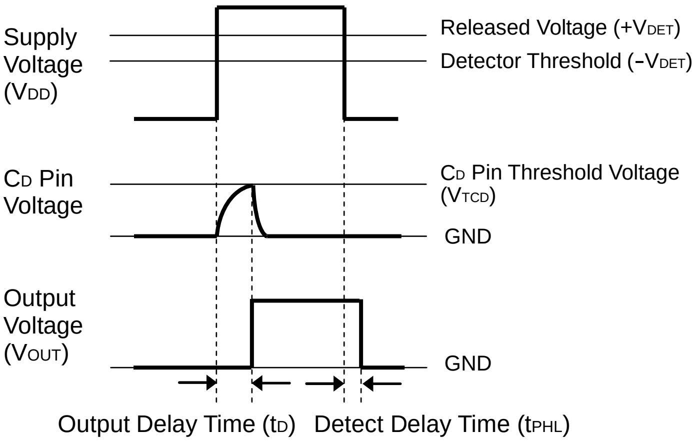
**All of unit are tested and specified under load conditions such that Topt=25°C except for Detector Threshold Temperature Coefficient.**

*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**

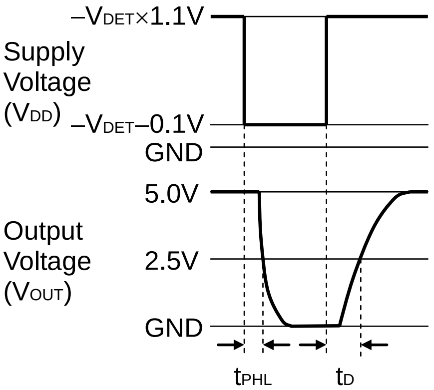
Output Delay Time ($t_D$) can be calculated with the next formula using the external capacitor:

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

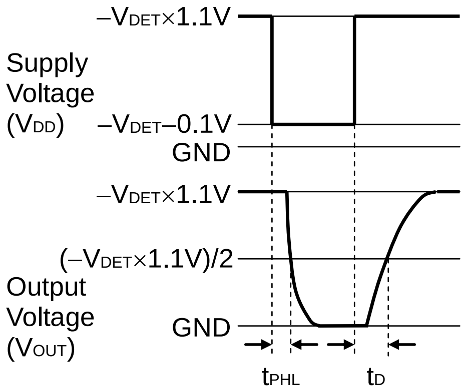
# DEFINITION OF OUTPUT DELAY TIME

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 $(-V_{DET})\times1.1V$ 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 $(-V_{DET})\times1.1V$ pulse voltage is supplied, the becoming of the output voltage to $((-V_{DET})\times1.1V)/2$.




**Nch Open Drain Output**
**(R3116xxx1A)**




**CMOS Output**
**(R3116xxx1C)**



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# 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 | 0.688 | 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 **0.55** ∗Note1 |
| 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** | | | | | | |
| 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** | | |
| 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] | | $\Delta$-$V_{DET}$/$\Delta T_{opt}$ [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 | $C_D$= 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** | | | | | | |

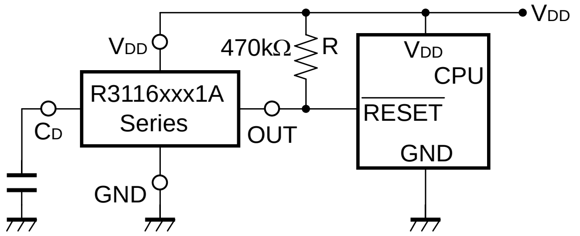
*Note2) 1. In the case of CMOS output type:
When the voltage is forced from (-$V_{DET}$)–0.1V to (-$V_{DET}$)×1.1V pulse voltage is added to $V_{DD}$, time interval that the output voltage reaches ((-$V_{DET}$)×1.1V)/2.

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.

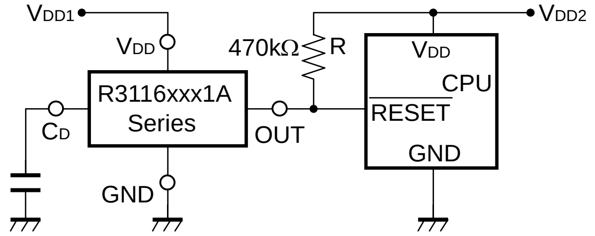
# TYPICAL APPLICATION

## ● R3116xxx1A CPU Reset Circuit 1 (Nch Open Drain Output)

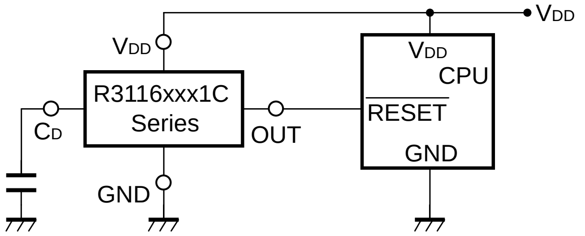
Case1. Input Voltage to R3116xxx1A is equal to Input Voltage to CPU



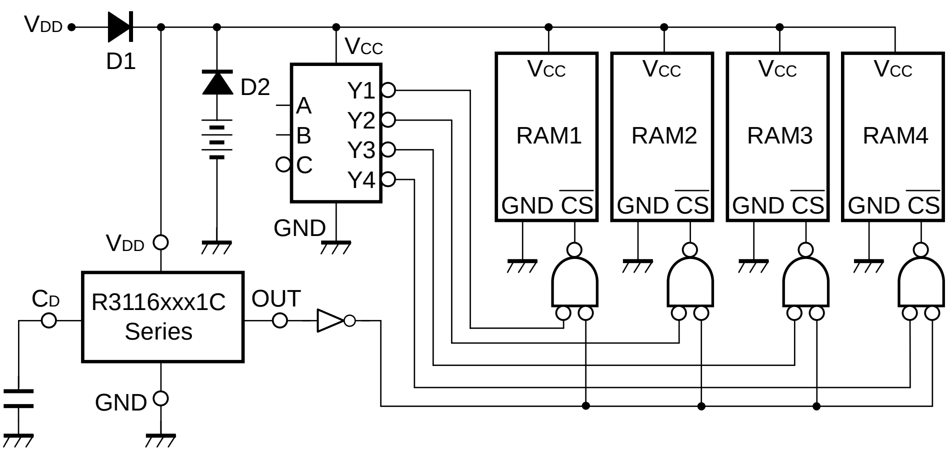

Case2. Input Voltage to R3116xxx1A is unequal to Input Voltage to CPU



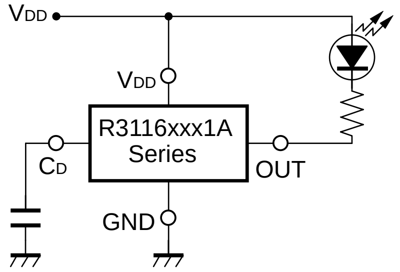

## ● R3116xxx1C CPU Reset Circuit 2 (CMOS Output)



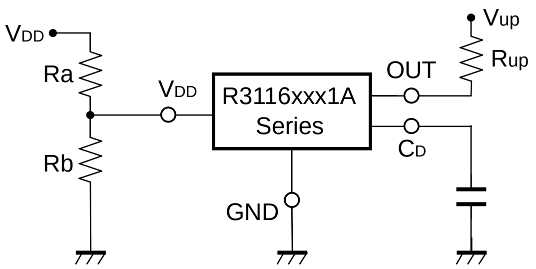

## ● Memory Back-up Circuit



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




## ● Detector Threshold Adjustable Circuit 1 (Nch Open Drain Output)

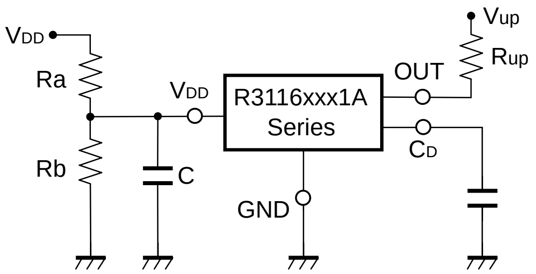



Adjustable Detector Threshold=(-$V_{DET}$)×(Ra+Rb)/Rb

Hysteresis Voltage=($V_{HYS}$)×(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 $V_{up}$ and $V_{DD}$ are connected, the voltage dropdown caused by $R_{up}$, may cause difference in the hysteresis voltage.

## ● Detector Threshold Adjustable Circuit 2 (Nch Open Drain Output)

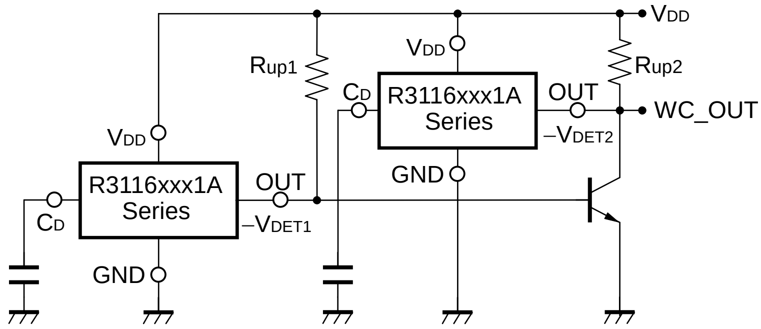


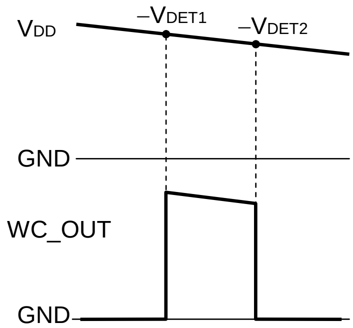

Adjustable Detector Threshold=(-$V_{DET}$)×(Ra+Rb)/Rb

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

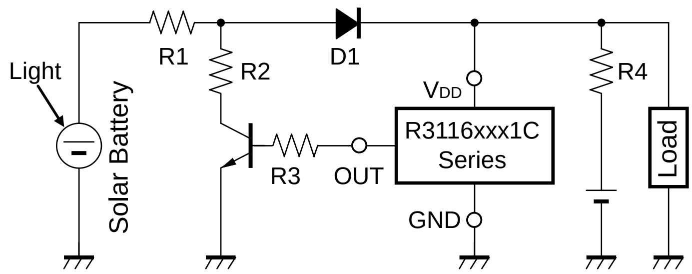
∗1) To prevent oscillation, set Ra ≦ 10kΩ, Rb ≦ 1kΩ, C ≧ 1μF.
∗2) If the value of Ra is set excessively large, voltage drop may occur caused by the supply current of IC itself, and detector threshold and hysteresis voltage may vary.
∗3) If $V_{up}$ and $V_{DD}$ are connected, the voltage dropdown caused by $R_{up}$, 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.

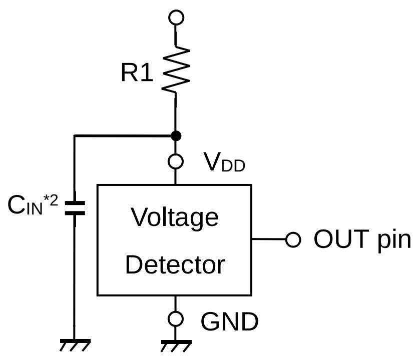



Figure A

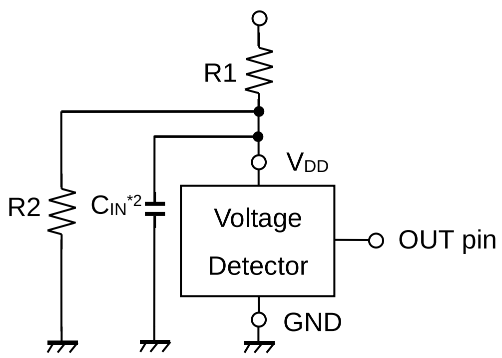



Figure B

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



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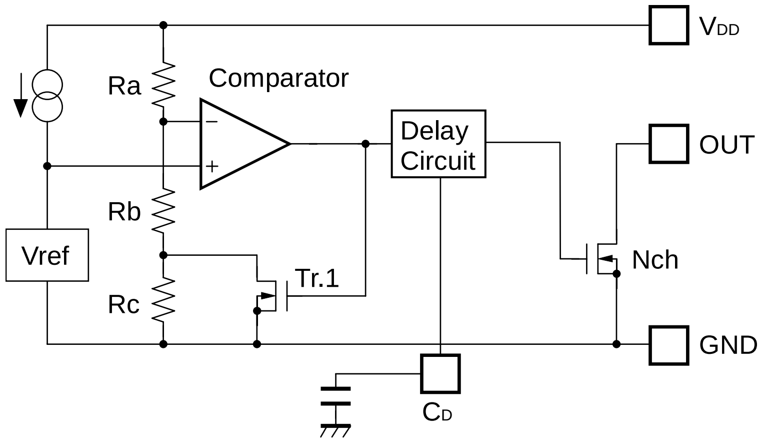
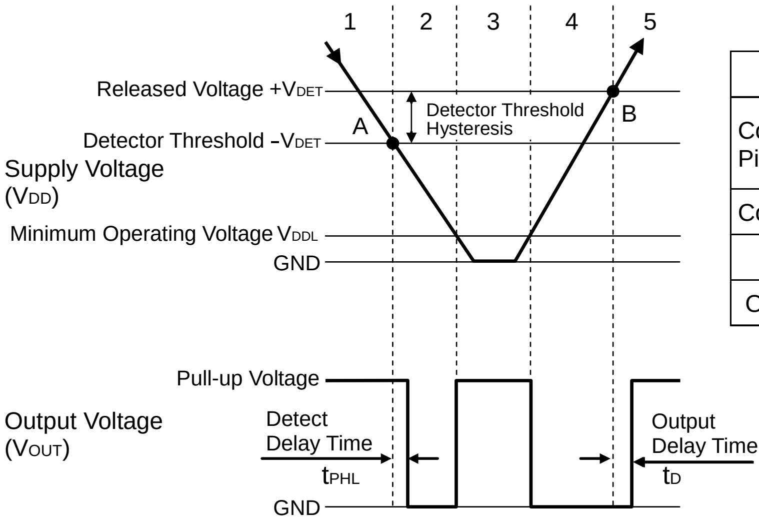
# OPERATION

## ● 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 |

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

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

**Operation Diagram**

## ● Explanation of operation

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

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

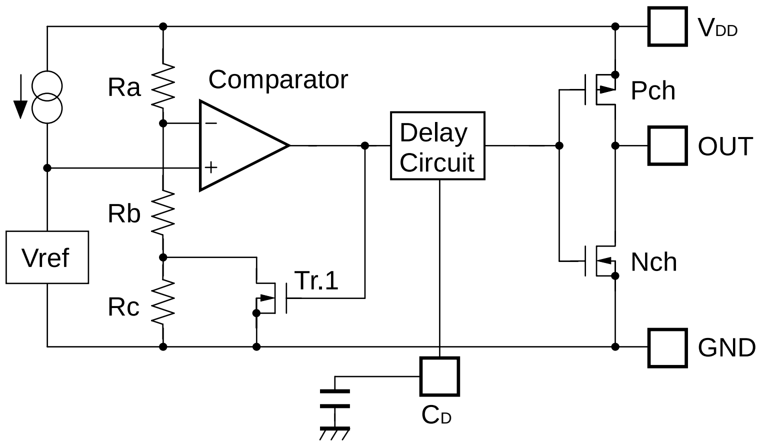
Step 3. When the supply voltage is lower than the minimum operating voltage, the operation of the output transistor becomes indefinite. The output voltage is equal to the pull-up voltage.

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

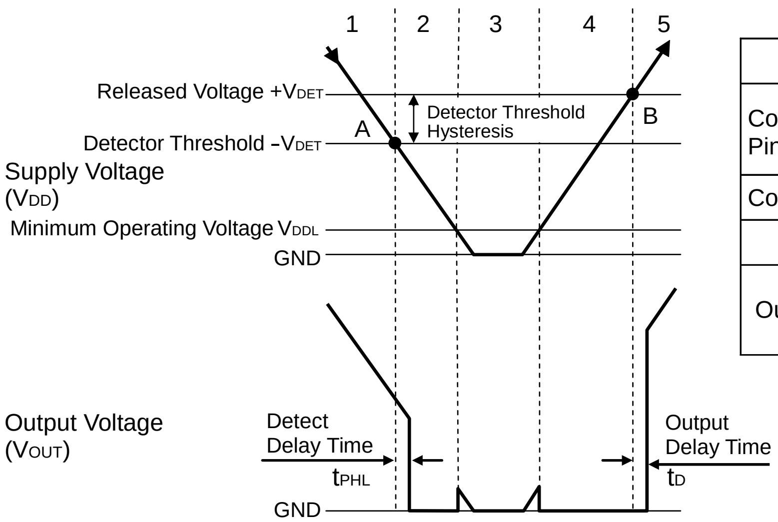
Step 5. At Point "B", Vref $\leqq$ $V_{DD}\times Rb/(Ra+Rb)$ is true, as a result, the output of comparator is reversed from "H" to "L", then the output voltage is equal to the pull-up voltage. The voltage level of Point B means a released voltage ($+V_{DET}$).

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

## • Operation of 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 $\dfrac{Rb+Rc}{Ra+Rb+Rc} \times V_{DD}$

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

**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.

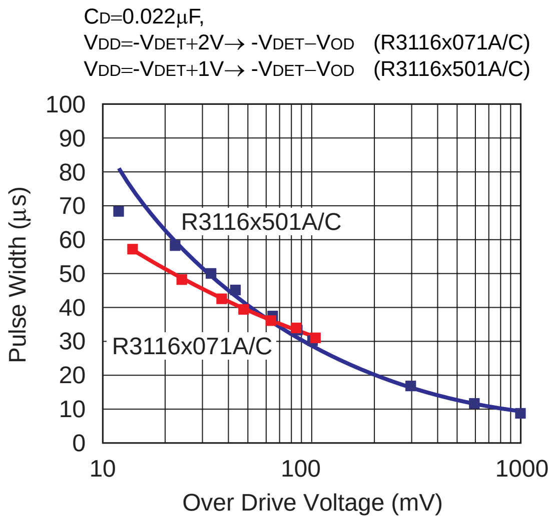
Step 4. The output voltage is equal to the GND level.

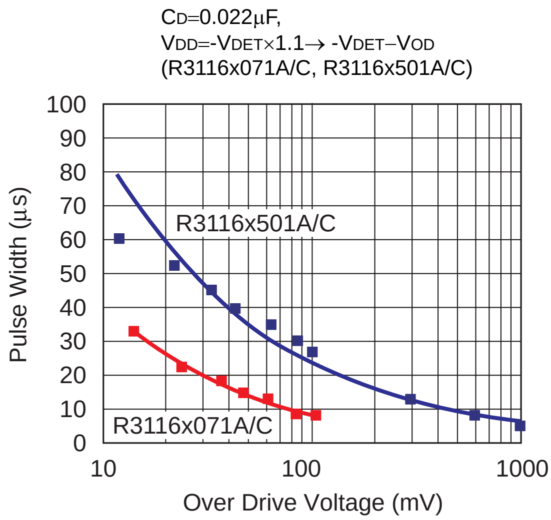
Step 5. At Point "B", Vref ≦ $V_{DD}$×Rb/(Ra+Rb) is true, as a result, the output of comparator is reversed from "H" to "L", then the output voltage is equal to the supply voltage ($V_{DD}$). The voltage level of Point B means a released voltage ($+V_{DET}$).

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

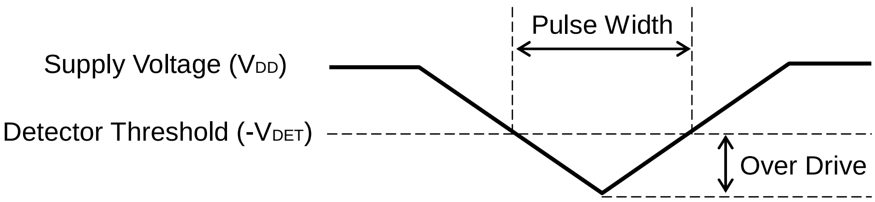
# Detector Operation vs. glitch input voltage to the $V_{DD}$ pin

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)

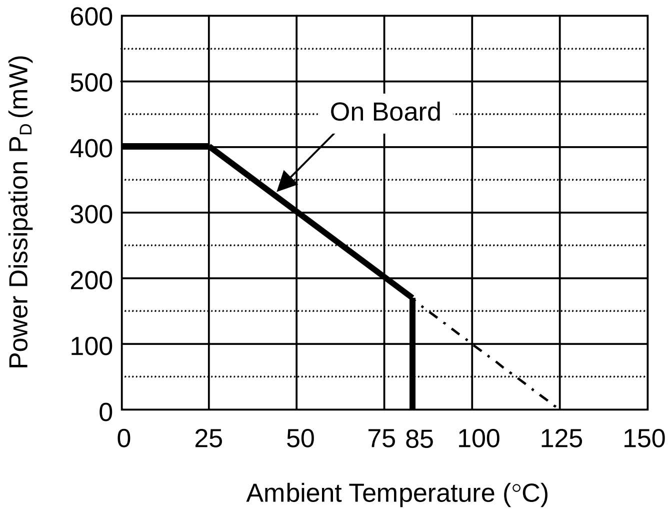
Power Dissipation ($P_D$) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

Measurement Conditions

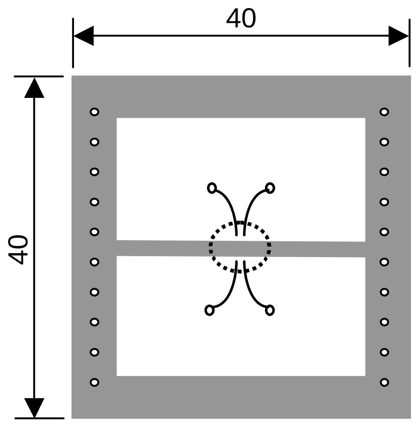
| | Standard Test Land Pattern |
|---|---|
| Environment | Mounting on Board (Wind velocity=0m/s) |
| Board Material | Glass cloth epoxy plastic (Double sided) |
| Board Dimensions | 40mm*40mm*1.6mm |
| Copper Ratio | Top side: Approx. 50%, Back side: Approx. 50% |
| Through-holes | ϕ 0.54mm * 24pcs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

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)



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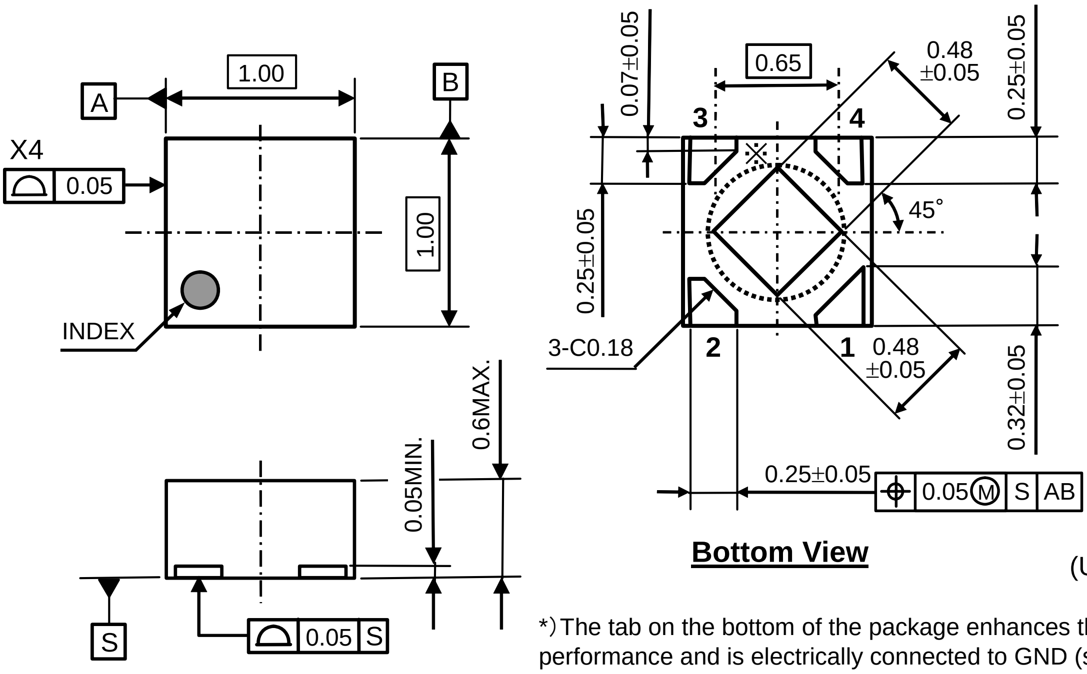
## PACKAGE DIMENSIONS (DFN(PLP)1010-4)



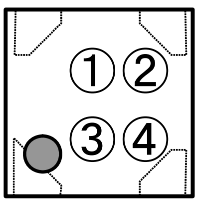

(Unit: mm)

*) 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 (SC-82AB)

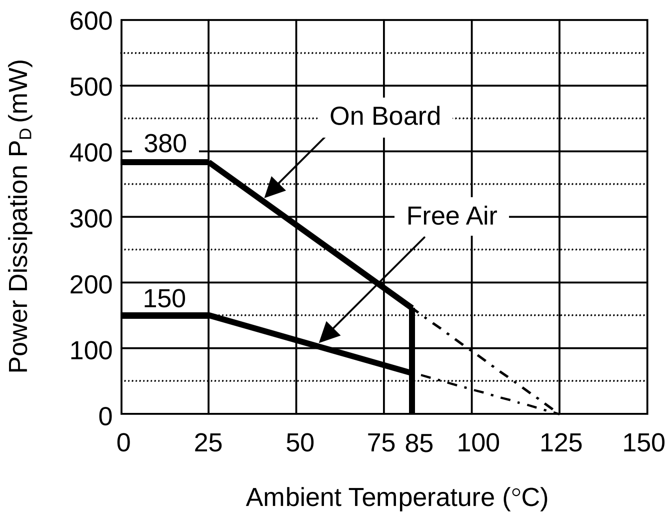
Power Dissipation ($P_D$) depends on conditions of mounting on board. This specification is based on the measurement at the condition below;

* Measurement Conditions

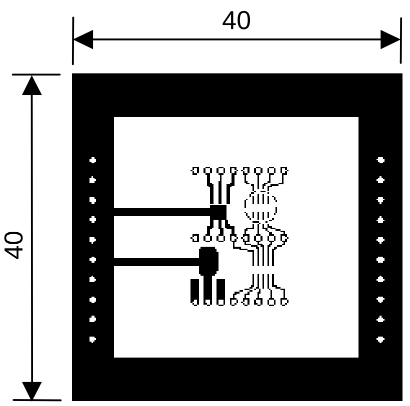
| | Standard Land Pattern |
|---|---|
| Environment | Mounting on Board (Wind velocity=0m/s) |
| Board Material | Glass cloth epoxy plastic (Double Layers) |
| Board Dimensions | 40mm × 40mm × 1.6mm |
| Copper Ratio | Top side: Approx. 50%, Back side: Approx. 50% |
| Through-hole | φ0.5mm × 44pcs |

* Measurement Result (Ta=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 |



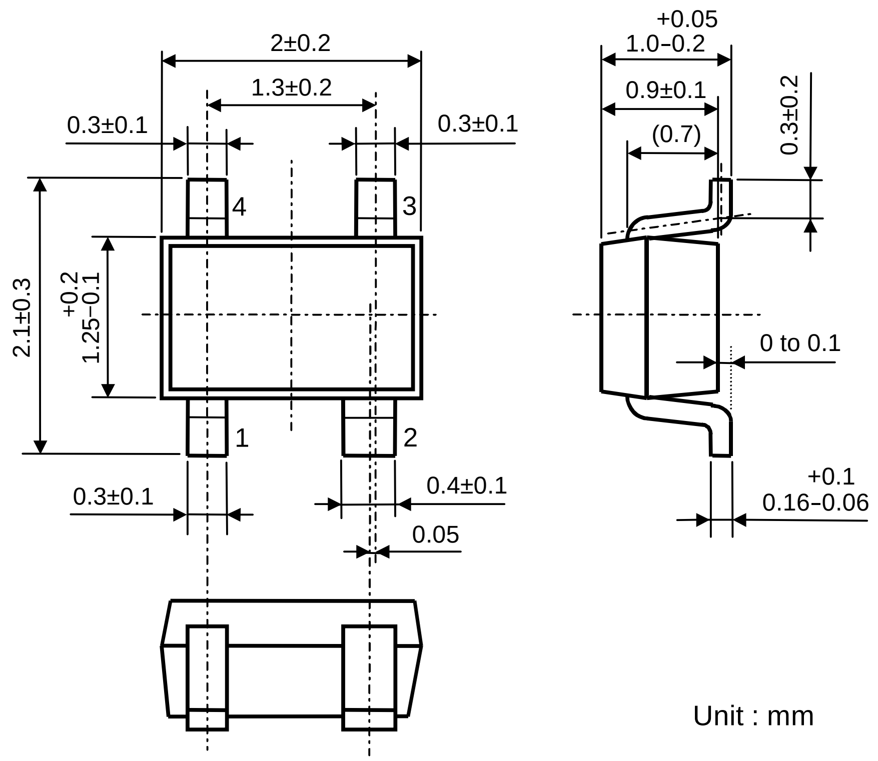

**Power Dissipation**




**Measurement Board Pattern**

IC Mount Area (Unit : mm)

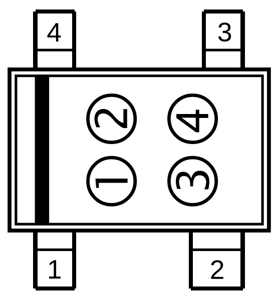
**PACKAGE DIMENSIONS (SC-82AB)**




**MARK SPECIFICATION (SC-82AB)**

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

③④: Lot Number … Alphanumeric Serial Number



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## MARK SPECIFICATION TABLE (SC-82AB)

**R3116Qxx1A**

| Product Name | ① ② | $V_{SET}$ |
|---|---|---|
| R3116Q071A | L 0 | 0.7V |
| R3116Q081A | L 1 | 0.8V |
| R3116Q091A | L 2 | 0.9V |
| R3116Q101A | L 3 | 1.0V |
| R3116Q111A | L 4 | 1.1V |
| R3116Q121A | L 5 | 1.2V |
| R3116Q131A | L 6 | 1.3V |
| R3116Q141A | L 7 | 1.4V |
| R3116Q151A | L 8 | 1.5V |
| R3116Q161A | L 9 | 1.6V |
| R3116Q171A | M 0 | 1.7V |
| R3116Q181A | M 1 | 1.8V |
| R3116Q191A | M 2 | 1.9V |
| R3116Q201A | M 3 | 2.0V |
| R3116Q211A | M 4 | 2.1V |
| R3116Q221A | M 5 | 2.2V |
| R3116Q231A | M 6 | 2.3V |
| R3116Q241A | M 7 | 2.4V |
| R3116Q251A | M 8 | 2.5V |
| R3116Q261A | M 9 | 2.6V |
| R3116Q271A | N 0 | 2.7V |
| R3116Q281A | N 1 | 2.8V |
| R3116Q291A | N 2 | 2.9V |
| R3116Q301A | N 3 | 3.0V |
| R3116Q311A | N 4 | 3.1V |
| R3116Q321A | N 5 | 3.2V |
| R3116Q331A | N 6 | 3.3V |
| R3116Q341A | N 7 | 3.4V |
| R3116Q351A | N 8 | 3.5V |
| R3116Q361A | N 9 | 3.6V |
| R3116Q371A | P 0 | 3.7V |
| R3116Q381A | P 1 | 3.8V |
| R3116Q391A | P 2 | 3.9V |
| R3116Q401A | P 3 | 4.0V |
| R3116Q411A | P 4 | 4.1V |
| R3116Q421A | P 5 | 4.2V |
| R3116Q431A | P 6 | 4.3V |
| R3116Q441A | P 7 | 4.4V |
| R3116Q451A | P 8 | 4.5V |
| R3116Q461A | P 9 | 4.6V |
| R3116Q471A | Q 0 | 4.7V |
| R3116Q481A | Q 1 | 4.8V |
| R3116Q491A | Q 2 | 4.9V |
| R3116Q501A | Q 3 | 5.0V |

**R3116Qxx1C**

| Product Name | ① ② | $V_{SET}$ |
|---|---|---|
| R3116Q071C | R 0 | 0.7V |
| R3116Q081C | R 1 | 0.8V |
| R3116Q091C | R 2 | 0.9V |
| R3116Q101C | R 3 | 1.0V |
| R3116Q111C | R 4 | 1.1V |
| R3116Q121C | R 5 | 1.2V |
| R3116Q131C | R 6 | 1.3V |
| R3116Q141C | R 7 | 1.4V |
| R3116Q151C | R 8 | 1.5V |
| R3116Q161C | R 9 | 1.6V |
| R3116Q171C | S 0 | 1.7V |
| R3116Q181C | S 1 | 1.8V |
| R3116Q191C | S 2 | 1.9V |
| R3116Q201C | S 3 | 2.0V |
| R3116Q211C | S 4 | 2.1V |
| R3116Q221C | S 5 | 2.2V |
| R3116Q231C | S 6 | 2.3V |
| R3116Q241C | S 7 | 2.4V |
| R3116Q251C | S 8 | 2.5V |
| R3116Q261C | S 9 | 2.6V |
| R3116Q271C | T 0 | 2.7V |
| R3116Q281C | T 1 | 2.8V |
| R3116Q291C | T 2 | 2.9V |
| R3116Q301C | T 3 | 3.0V |
| R3116Q311C | T 4 | 3.1V |
| R3116Q321C | T 5 | 3.2V |
| R3116Q331C | T 6 | 3.3V |
| R3116Q341C | T 7 | 3.4V |
| R3116Q351C | T 8 | 3.5V |
| R3116Q361C | T 9 | 3.6V |
| R3116Q371C | U 0 | 3.7V |
| R3116Q381C | U 1 | 3.8V |
| R3116Q391C | U 2 | 3.9V |
| R3116Q401C | U 3 | 4.0V |
| R3116Q411C | U 4 | 4.1V |
| R3116Q421C | U 5 | 4.2V |
| R3116Q431C | U 6 | 4.3V |
| R3116Q441C | U 7 | 4.4V |
| R3116Q451C | U 8 | 4.5V |
| R3116Q461C | U 9 | 4.6V |
| R3116Q471C | V 0 | 4.7V |
| R3116Q481C | V 1 | 4.8V |
| R3116Q491C | V 2 | 4.9V |
| R3116Q501C | V 3 | 5.0V |

## POWER DISSIPATION (SOT-23-5)

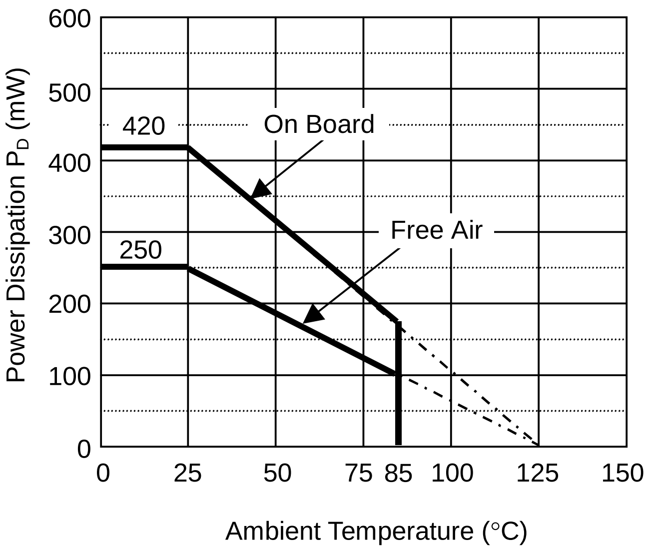
Power Dissipation ($P_D$) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:
(Power Dissipation (SOT-23-5) is substitution of SOT-23-6.)

* Measurement Conditions

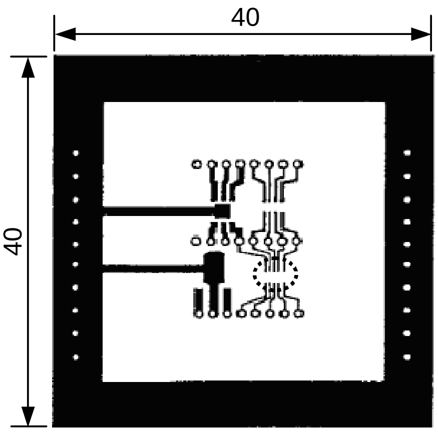
| | Standard Test Land Pattern |
|---|---|
| Environment | Mounting on Board (Wind velocity=0m/s) |
| Board Material | Glass cloth epoxy plastic (Double sided) |
| Board Dimensions | 40mm*40mm*1.6mm |
| Copper Ratio | Top side: Approx. 50%, Back side: Approx. 50% |
| Through-holes | ϕ 0.5mm * 44pcs |

* 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**



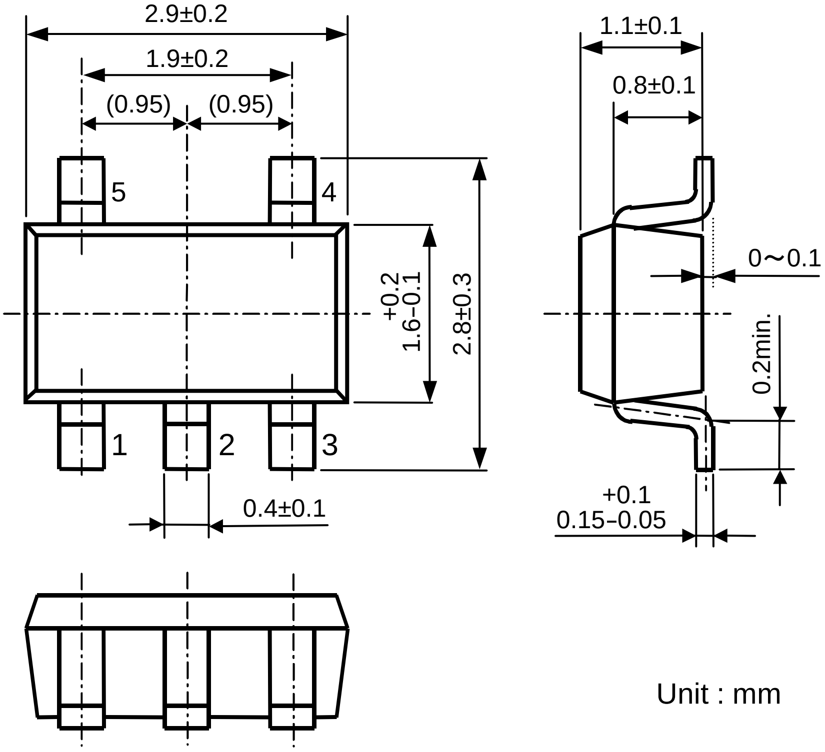

**Measurement Board Pattern**

IC Mount Area (Unit: mm)



RICOH

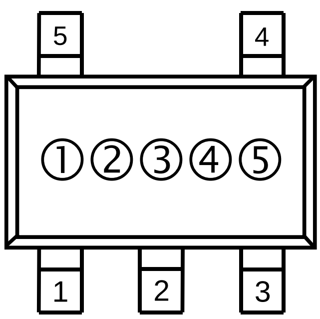
## PACKAGE DIMENSIONS (SOT-23-5)




## 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**

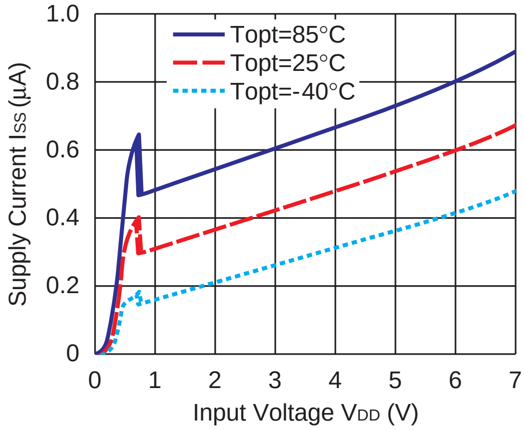
| Product Name | ①②③ | $V_{SET}$ |
|---|---|---|
| R3116N071C | D 1 A | 0.7V |
| R3116N081C | D 1 B | 0.8V |
| R3116N091C | D 1 C | 0.9V |
| R3116N101C | D 1 D | 1.0V |
| R3116N111C | D 1 E | 1.1V |
| R3116N121C | D 1 F | 1.2V |
| R3116N131C | D 1 G | 1.3V |
| R3116N141C | D 1 H | 1.4V |
| R3116N151C | 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

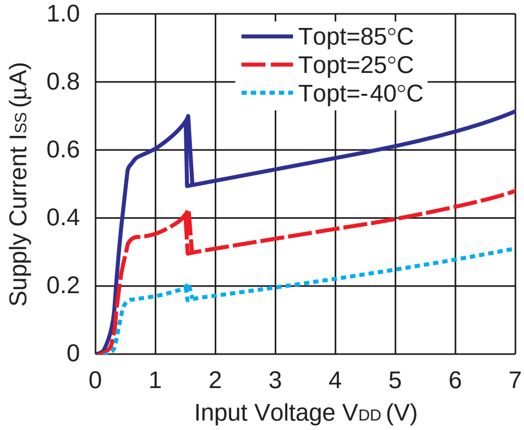
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

## 1) Supply Current vs. Input Voltage

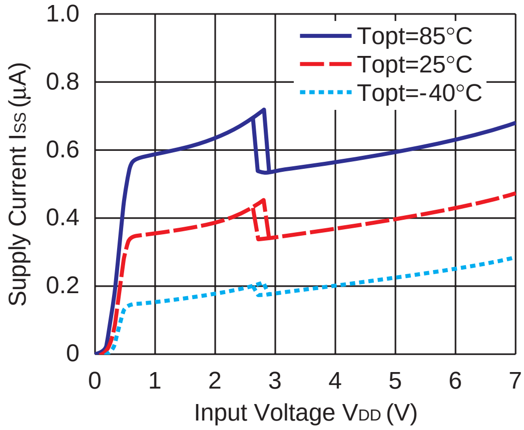
**R3116x071A/C**



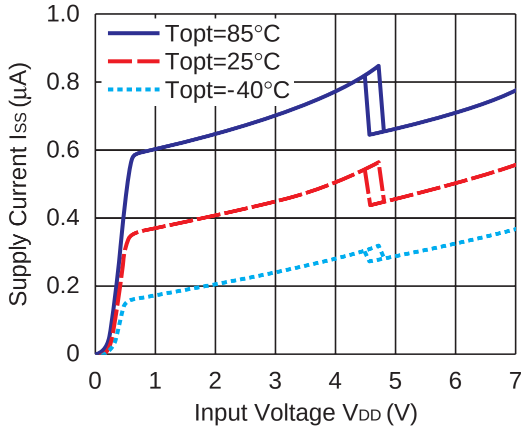

**R3116x151A/C**




**R3116x271A/C**

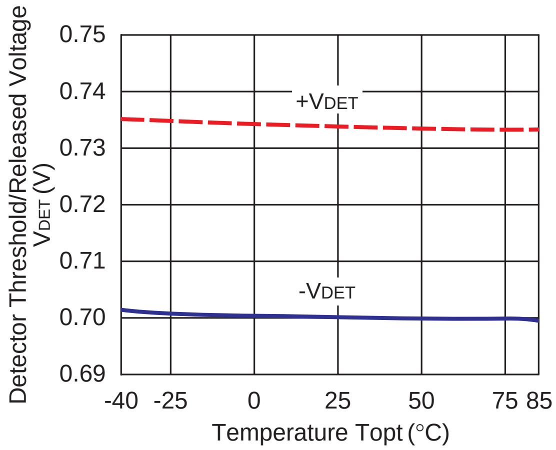



**R3116x451A/C**

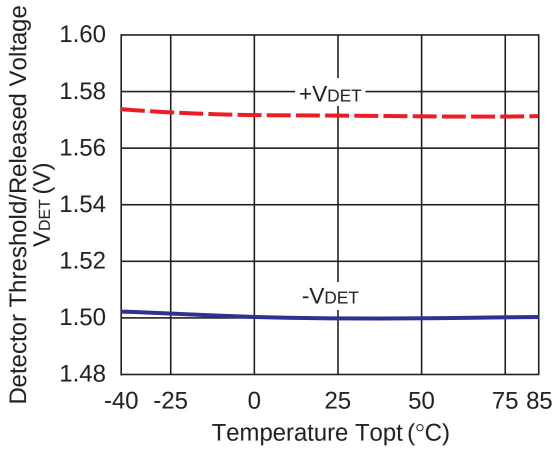


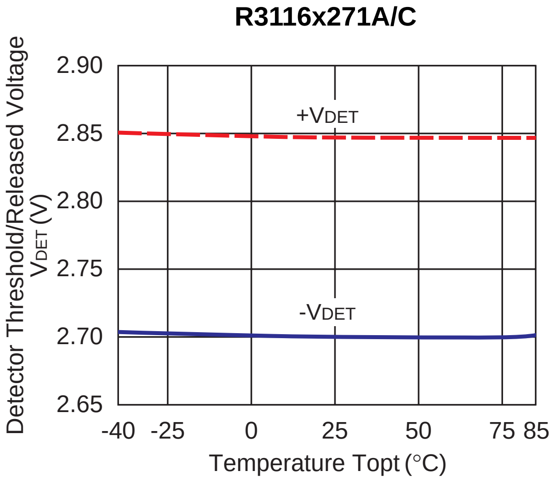

## 2) Detector Threshold vs. Temperature

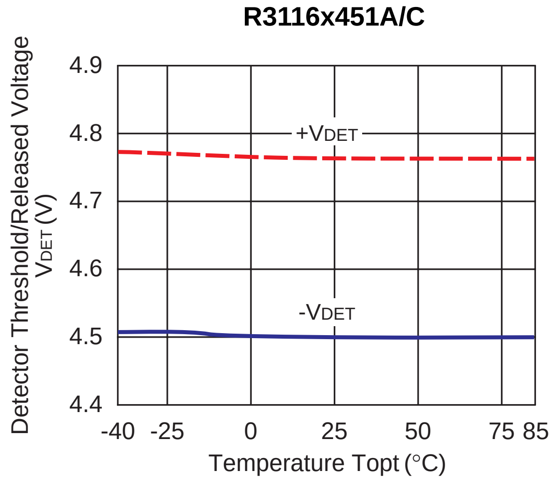
**R3116x071A/C**



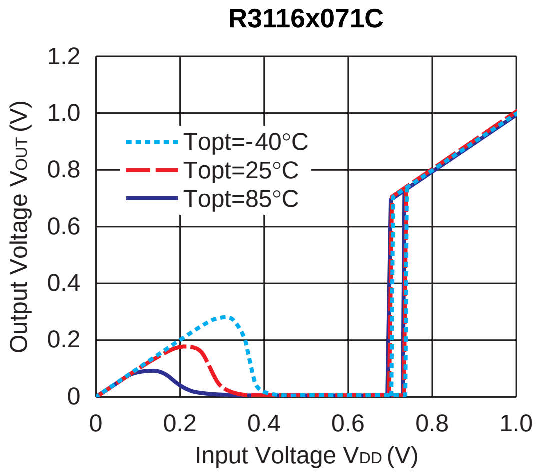

**R3116x151A/C**

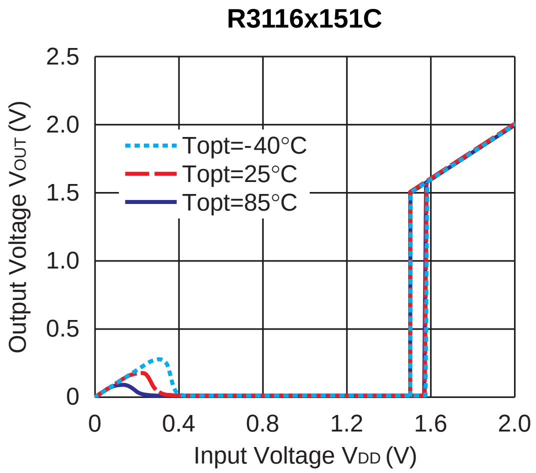


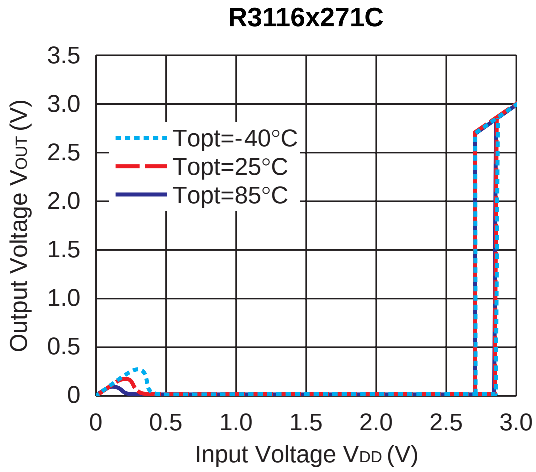


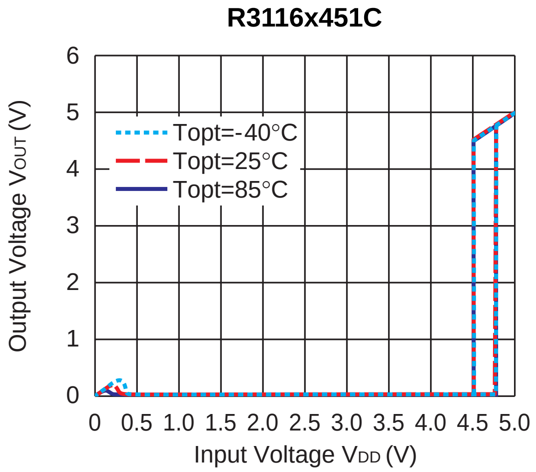




### 3) Output Voltage vs. Input Voltage



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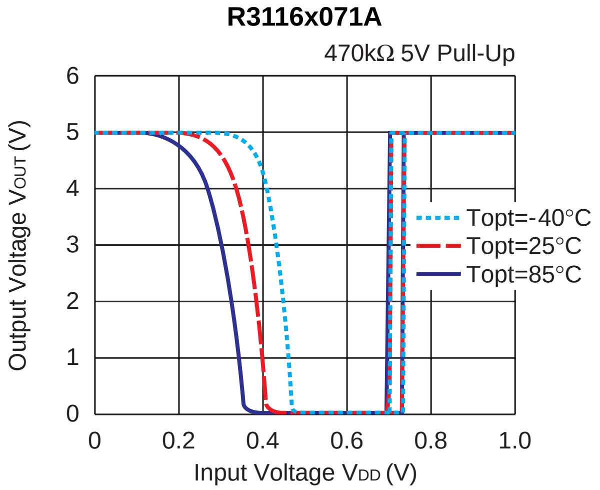
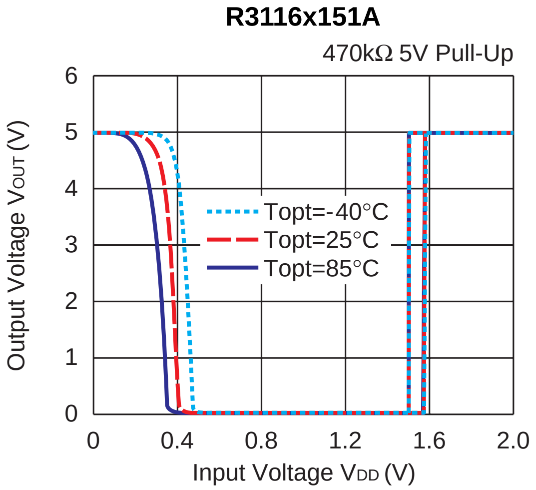
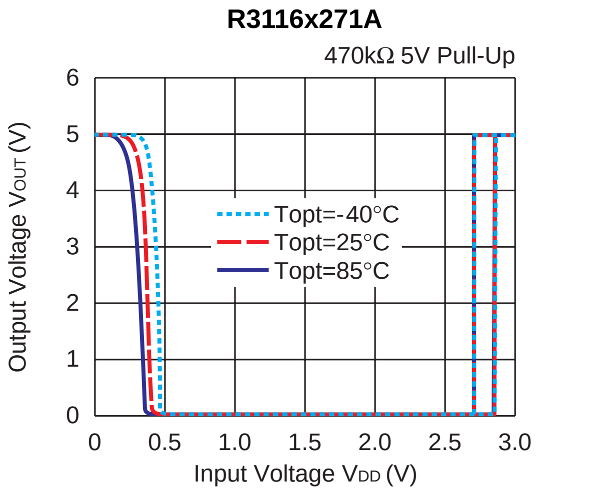
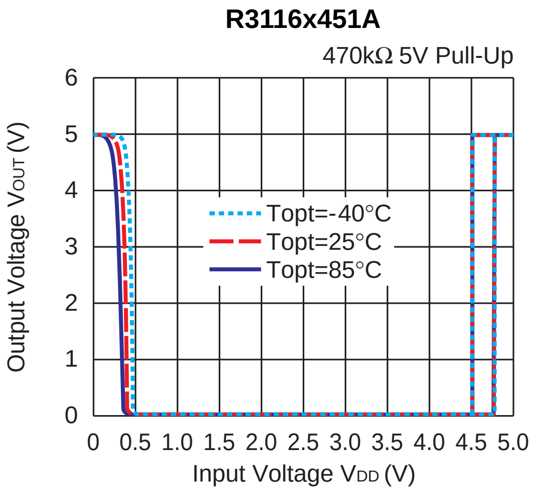
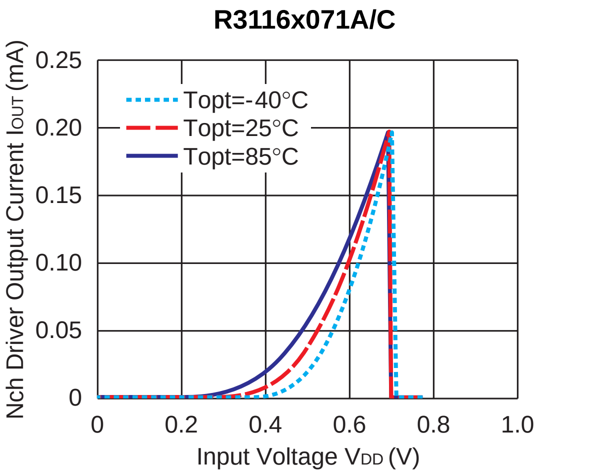


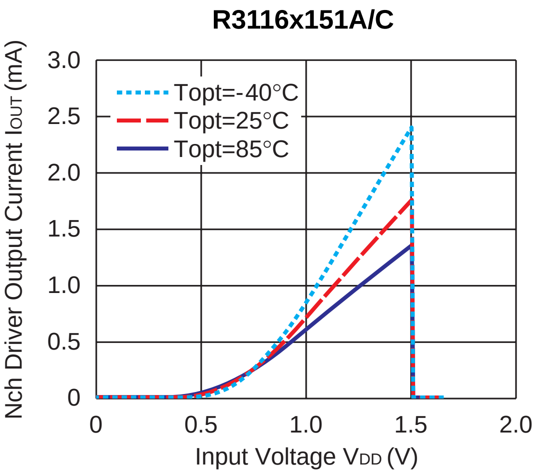



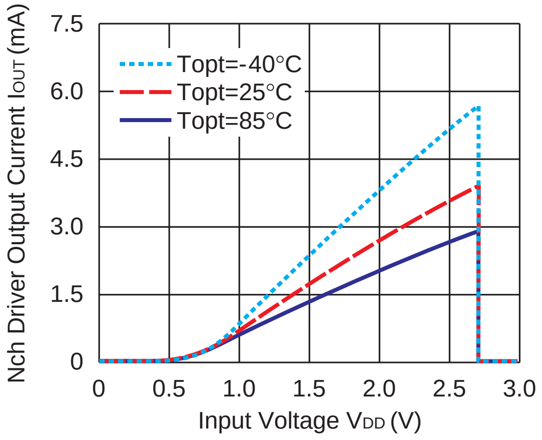




### 4) Nch Driver Output Current vs. Input Voltage ($V_{DS}$=0.5V)

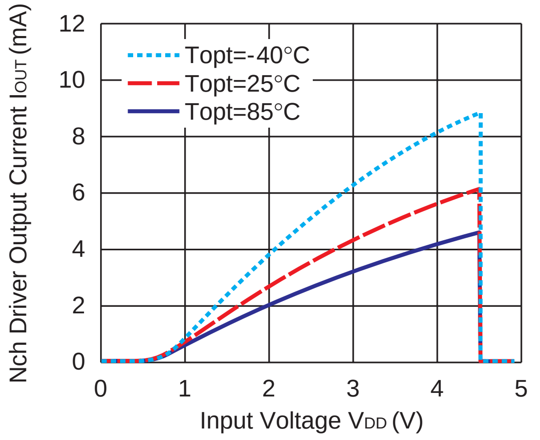


R3116x271A/C

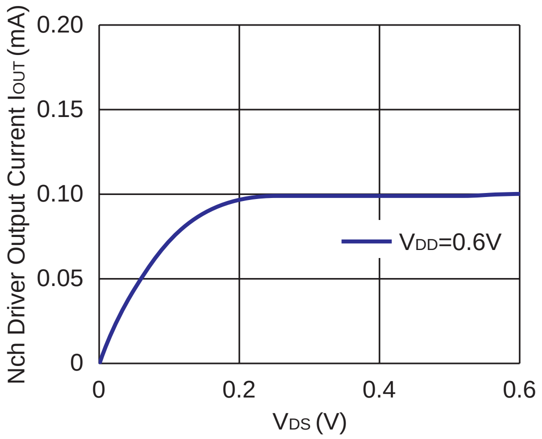



R3116x451A/C

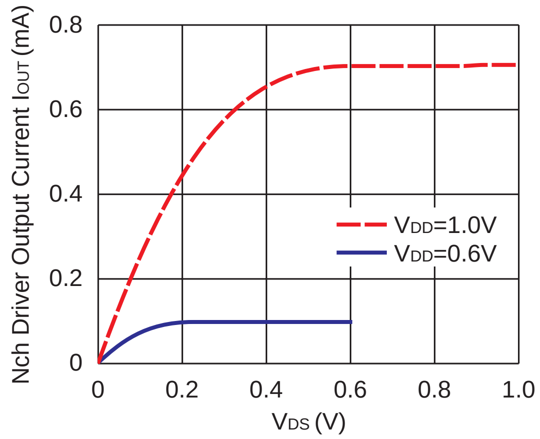



### 5) Nch Driver Output Current vs. $V_{DS}$

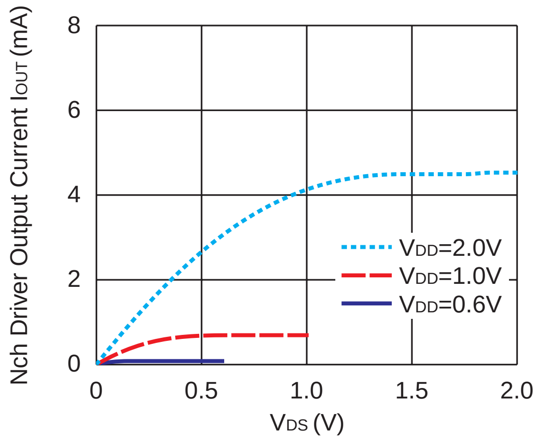
R3116x071A/C



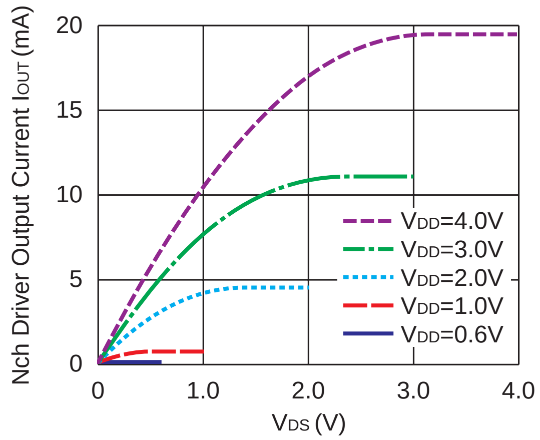

R3116x151A/C



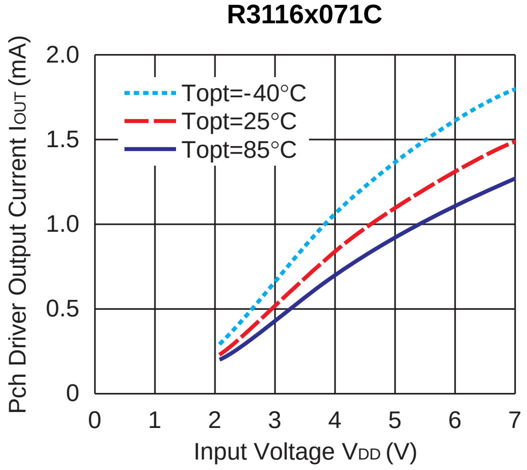

R3116x271A/C

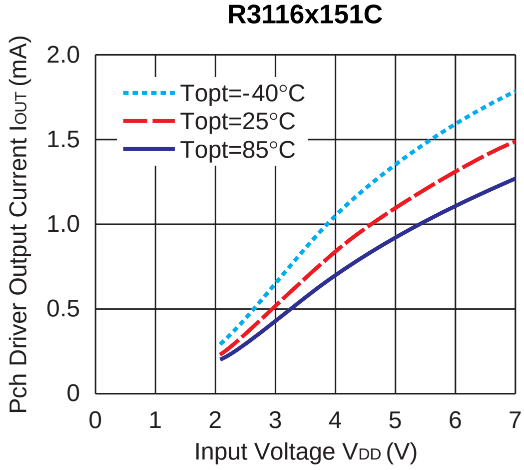


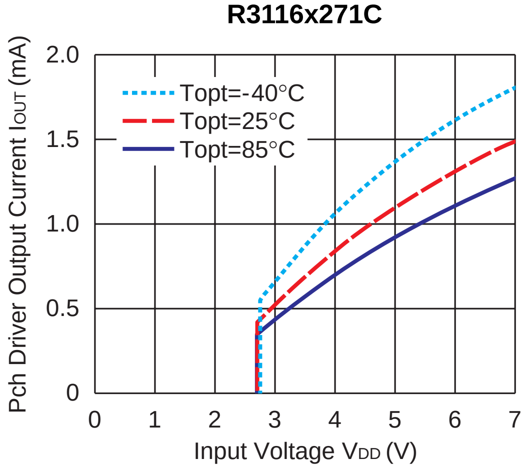

R3116x451A/C

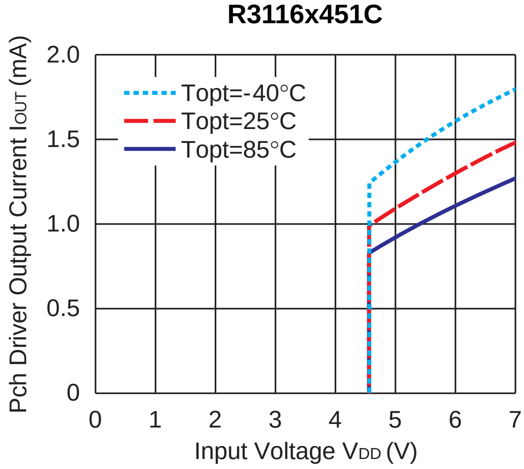


### 6) Pch Driver Output Current vs. Input Voltage ($V_{DS}$=–2.1V)

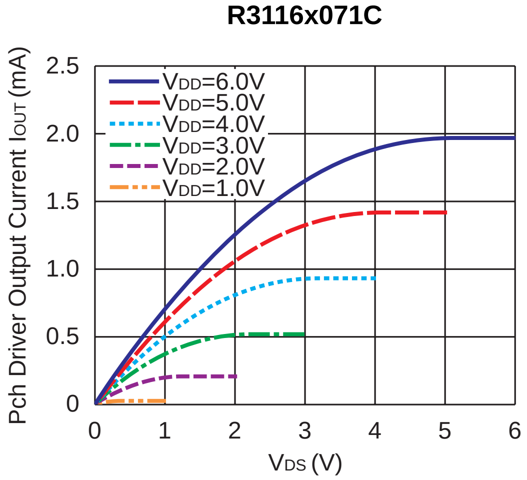


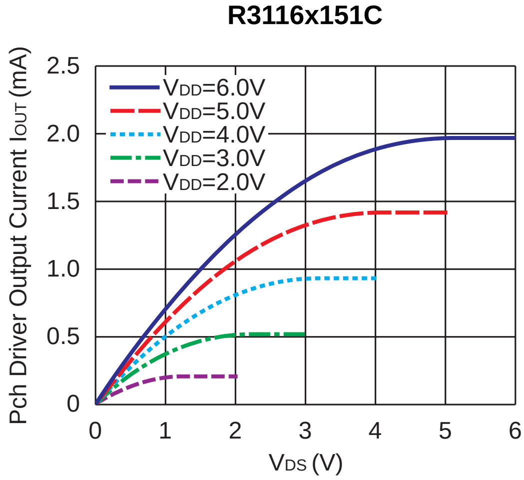



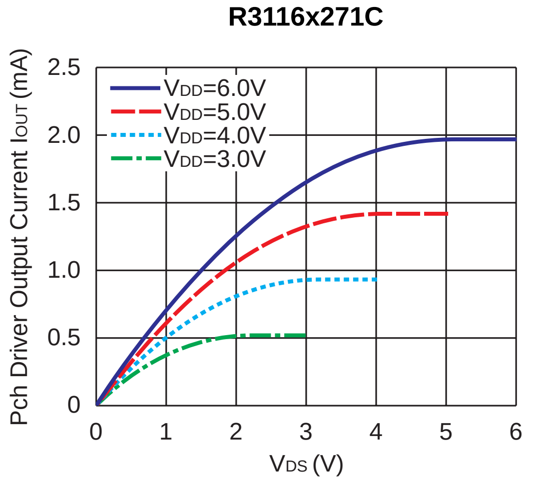



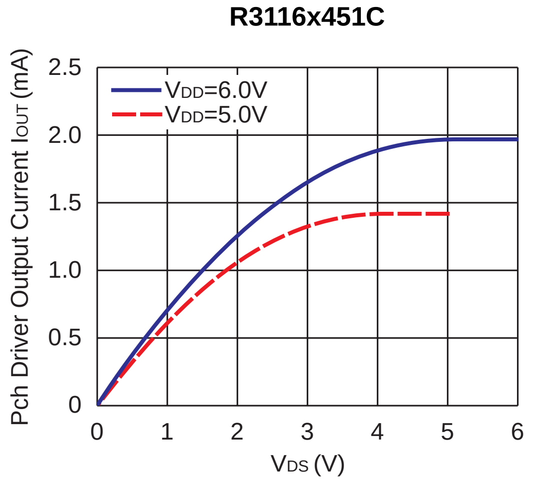




### 7) Pch Driver Output Current vs. $V_{DS}$

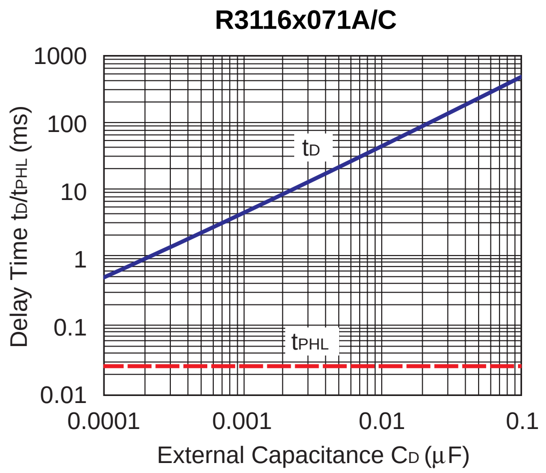


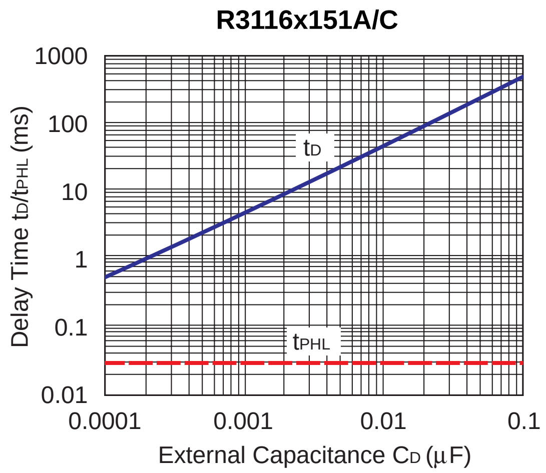



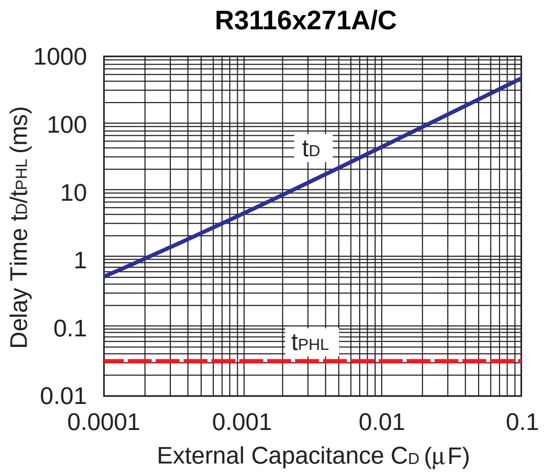


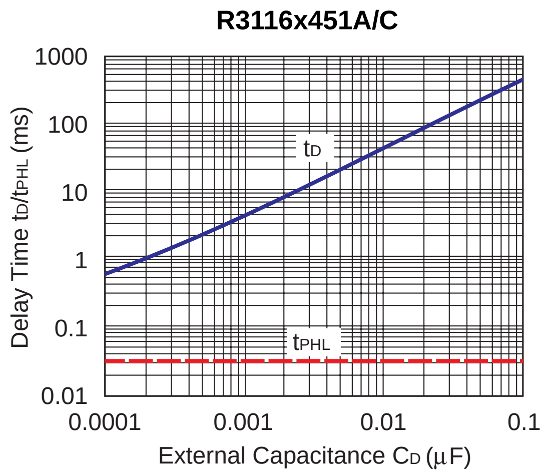




### 8) Output Delay Time vs. External Capacitance



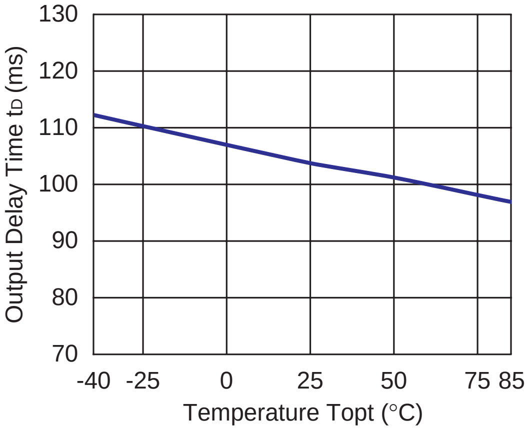



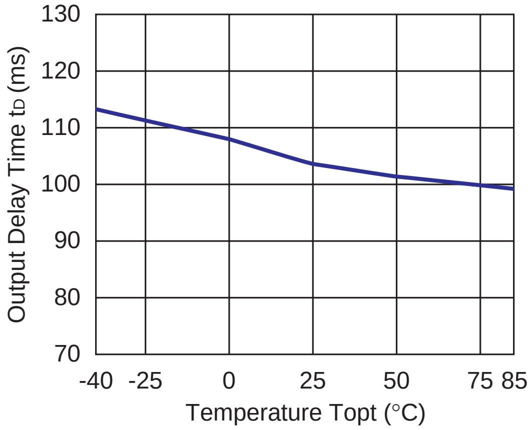



### 9) Output Delay Time vs. Temperature ($C_D$=22nF)

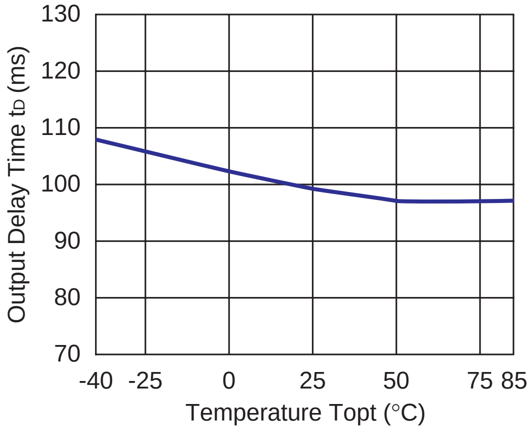
**R3116x071A/C**



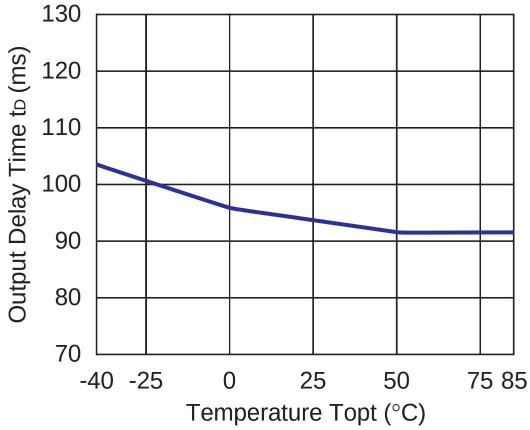

**R3116x151A/C**




**R3116x271A/C**




**R3116x451A/C**



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11. Please contact Ricoh sales representatives should you have any questions or comments concerning the products or the technical information.

RoHS Compliant
Halogen Free

**Ricoh is committed to reducing the environmental loading materials in electrical devices with a view to contributing to the protection of human health and the environment.**
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RICOH ELECTRONIC DEVICES CO., LTD.

https://www.e-devices.ricoh.co.jp/en/


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