

Microprocessor Supervisory Circuit

NO.EA-159-080808

OUTLINE

The R5105N Series are CMOS-based microprocessor supervisory circuit, or high accuracy and ultra low supply current voltage detector with built-in delay circuit and watchdog timer. When the supply voltage is down across the threshold, or the watchdog timer does not detect the system clock from the microprocessor, the reset output is generated.

The voltage detector circuit is used for the system reset, etc. The detector threshold is fixed internally, and the accuracy is $\pm 1.0\%$. The released delay time (Power-on Reset Delay) circuit is built-in, and output delay time is adjustable with an external capacitor, and the accuracy is $\pm 16\%^*$. When the supply voltage becomes higher than the released voltage, the reset state will be maintained during the delay time. The output type of the reset is selectable, Nch open-drain, or CMOS.

The time out period of the watchdog timer can be also set with an external capacitor, and the accuracy is $\pm 33\%^*$.

There are another 4 products by the difference of packages and the function of voltage detector and watchdog timer. The package of R5105N is SOT-23-6.

FEATURES

- Supply Current..... Typ. 11 μ A
- Operating Voltage Range 0.9V to 6.0V

< Voltage Detector Part >

- Detector Threshold Range..... Stepwise setting with a step of 0.1V in the range of 1.5V to 5.5V
- Detector Threshold Accuracy..... $\pm 1.0\%$
- Power-on Reset Delay Time accuracy $\pm 16\%^*$ ($-40^{\circ}\text{C} \leq T_{\text{opt}} \leq 105^{\circ}\text{C}$)
- Power-on reset delay time of the voltage detector Typ. 370ms with an external capacitor : 0.1 μ F

< Watchdog Timer Part >

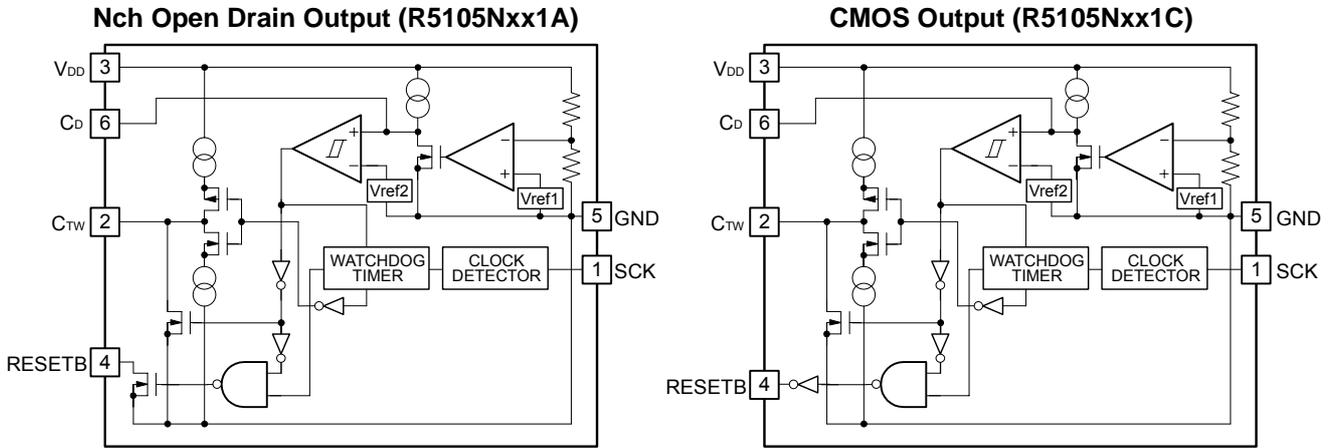
- Built-in a watchdog timer's time out period accuracy $\pm 33\%^*$ ($-40^{\circ}\text{C} \leq T_{\text{opt}} \leq 105^{\circ}\text{C}$)
- Timeout period for watchdog timer Typ. 310ms with an external capacitor : 0.1 μ F
- Reset timer for watchdog timer..... Typ. 34ms with an external capacitor : 0.1 μ F
- Package..... SOT-23-6

*) Accuracy to center value of (Min.+Max.)/2

APPLICATIONS

- Supervisory circuit for equipment with using microprocessors.

BLOCK DIAGRAMS



SELECTION GUIDE

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;

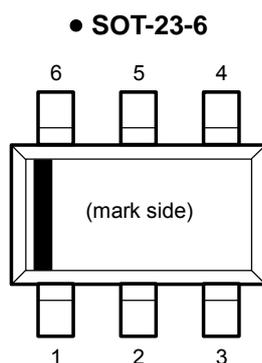
R5105N \overline{xx} 1 \overline{x} - \overline{xx} - \overline{x} ← Part Number
 ↑ ↑ ↑ ↑ ↑
 a b c d e

Code	Contents
a	Designation of Package Type; N: SOT-23-6
b	Setting Detector Threshold ($-V_{DET}$); Stepwise setting with a step of 0.1V in the range of 1.5V to 5.5V 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-23-6)

SERIES SELECTION

	R5105N	R5106N	R5107G	R5108G	R5109G
Package	SOT-23-6		SSOP-8G		
With INH pin (Inhibit)	No	Yes			
2 clock input	No				Yes
With MR pin (Manual Reset)	No		Yes	No	
With SENSE pin	No			Yes	No
Remarks		C _D pin and C _{TW} pin are combined uses.		Operating Voltage Range 1.5V to 6.0V	Supply Current 11.5μA

PIN CONFIGURATION



PIN DESCRIPTIONS

• SOT-23-6

Pin No.	Symbol	Description
1	SCK	Clock Input Pin from Microprocessor
2	C _{TW}	External Capacitor Pin for setting Reset and Watchdog Timer Timeout Period
3	V _{DD}	Power supply Pin
4	RESETB	Output Pin for Reset signal of Watchdog timer and Voltage Detector. (Output "L" at detecting Detector Threshold and Watchdog Timer Reset.)
5	GND	Ground Pin
6	C _D	External Capacitor Pin for Setting delay time of Voltage Detector

ABSOLUTE MAXIMUM RATINGST_{opt}=25°C

Symbol	Item		Rating	Unit
V _{DD}	Supply Voltage		-0.3 to 7.0	V
V _{CD}	Output Voltage	Voltage of C _D Pin	-0.3 to V _{DD} + 0.3	V
V _{CTW}		Voltage of C _{TW} Pin	-0.3 to V _{DD} + 0.3	V
V _{RESETB}		Voltage of RESETB Pin	-0.3 to 7.0	V
V _{SCK}	Input Voltage	Voltage of SCK Pin	-0.3 to 7.0	V
I _{RESETB}	Output Current	Current of RESETB Pin	20	mA
P _D	Power Dissipation (SOT-23-6)*		420	mW
T _{opt}	Operating Temperature Range		-40 to 105	°C
T _{stg}	Storage Temperature Range		-55 to 125	°C

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

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field.

The functional operation at or over these absolute maximum ratings is not assured.

ELECTRICAL CHARACTERISTICS

$V_{DD}=6.0V$, $C_{TW}=0.1\mu F$, $C_D=0.1\mu F$, In case of Nch Open Drain Output type, the output pin is pulled up with a resistance of $100k\Omega$ (R5105Nxx1A), unless otherwise noted.

The specification in is checked and guaranteed by design engineering at $-40^{\circ}C \leq T_{opt} \leq 105^{\circ}C$.

• R5105Nxx1A/C

$T_{opt}=25^{\circ}C$

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{DD}	Operating Voltage		<input type="checkbox"/> 0.9		<input type="checkbox"/> 6.0	V
I_{SS}	Supply Current	$V_{DD}=-V_{DET}+0.5V$, Clock pulse input		11	<input type="checkbox"/> 15	μA

• VD Part

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold	$T_{opt}=25^{\circ}C$	$\times 0.990$		$\times 1.010$	V
		$-40^{\circ}C \leq T_{opt} \leq 105^{\circ}C$	<input type="checkbox"/> $\times 0.972$		<input type="checkbox"/> $\times 1.015$	
V_{HYS}	Detector Threshold Hysteresis		$\frac{-V_{DET}}{\times 0.03}$	$\frac{-V_{DET}}{\times 0.05}$	$\frac{-V_{DET}}{\times 0.07}$	V
$\frac{\Delta -V_{DET}}{\Delta T_{opt}}$	Detector Threshold Temperature Coefficient	$-40^{\circ}C \leq T_{opt} \leq 105^{\circ}C$		± 100		ppm/ $^{\circ}C$
t_{PLH}	Output Delay Time	$C_D=0.1\mu F$ *1	<input type="checkbox"/> 340	370	<input type="checkbox"/> 467	ms
I_{RESETB}	Output Current (RESETB Output pin)	Nch $V_{DD}=1.2V$ $V_{DS}=0.1V$	<input type="checkbox"/> 0.38	0.8		mA
		Pch *2 $V_{DD}=6.0V$ $V_{DS}=0.5V$	<input type="checkbox"/> 0.65	0.9		mA

• WDT Part

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
t_{WD}	Watchdog Timeout period	$C_{TW}=0.1\mu F$ *1	<input type="checkbox"/> 230	310	<input type="checkbox"/> 450	ms
t_{WR}	Reset Hold Time of WDT	$C_{TW}=0.1\mu F$ *1	<input type="checkbox"/> 29	34	<input type="checkbox"/> 48	ms
V_{SCKH}	SCK Input "H"		$V_{DD} \times 0.8$		<input type="checkbox"/> 6.0	V
V_{SCKL}	SCK Input "L"		<input type="checkbox"/> 0		$V_{DD} \times 0.2$	V
t_{SCKW}	SCK Input Pulse Width	$V_{SCKL}=V_{DD} \times 0.2$ $V_{SCKH}=V_{DD} \times 0.8$	<input type="checkbox"/> 500			ns

All of unit are tested and specified under load conditions such that $T_{opt}=25^{\circ}C$ except for Detector Threshold Temperature Coefficient.

*1) The specification does not contain the temperature characteristics of the external capacitor.

*2) In case of CMOS type (R5105Nxx1C)

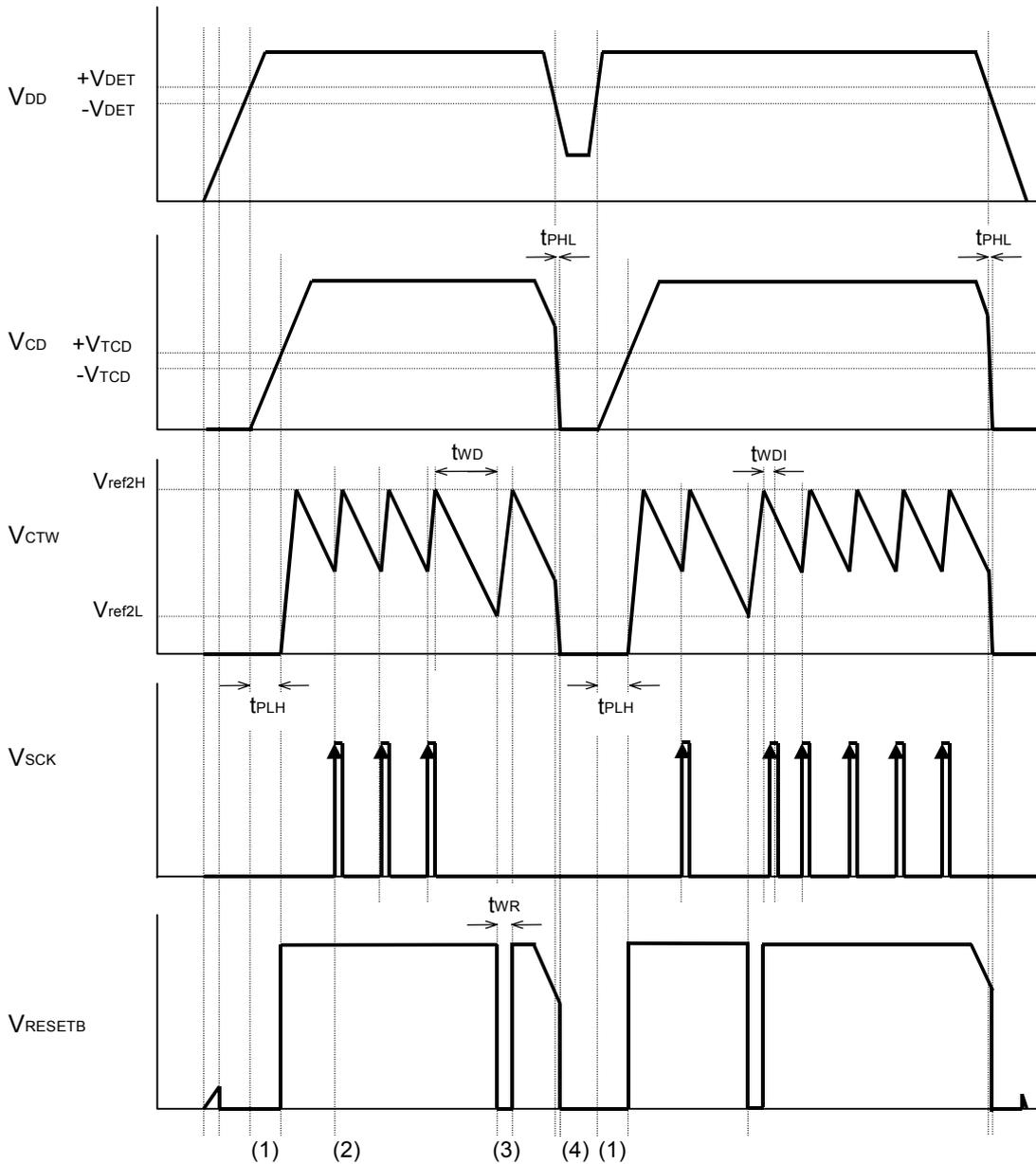
RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

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.

TIMING CHART



*) V_{TCD} : Threshold voltage of C_D pin when a power-on reset pulse inverting.

*) V_{ref2H} : C_{TW} pin voltage at the end of WDT timeout period.

*) V_{ref2L} : C_{TW} pin voltage at the begin of WDT timeout period.

OPERATION

- (1) When the power supply, V_{DD} pin voltage becomes more than the released voltage (+V_{DET}), after the released delay time (or the power on reset time t_{PLH}), the output of RESETB becomes "H" level.
- (2) When the SCK pulse is input, the watchdog timer (WDT) is cleared, and C_{TW} pin mode changes from the discharge mode to the charge mode. When the C_{TW} pin voltage becomes higher than V_{refH}, the mode will change into the discharge mode, and next watchdog time count starts.
- (3) Unless the SCK pulse is input, WDT will not be cleared, and during the charging period of C_{TW} pin, RESETB="L".
- (4) When the V_{DD} pin becomes lower than the detector threshold voltage(-V_{DET}), RESETB outputs "L".

• Watchdog Timeout period/Reset hold time

The watchdog timeout period and reset hold time can be set with an external capacitor to C_{TW} pin.

The next equations describe the relation between the watchdog timeout period and the external capacitor value, or the reset hold time and the external capacitor value.

$$t_{WD} (s) = 3.1 \times 10^6 \times C (F)$$

$$t_{WR} (s) = t_{WD}/9$$

The watchdog timer (WDT) timeout period is determined with the discharge time of the external capacitor.

During the watchdog timeout period, if the clock pulse from the system is detected, WDT is cleared and the capacitor is charged. When the charge of the capacitor completes, another watchdog timeout period starts again. During the watchdog timeout period, if the clock pulse from the system is not detected, during the next reset hold time RESETB pin outputs "L".

After starting the watchdog timeout period, (just after from the discharge of the external capacitor) even if the clock pulse is input during the time period " t_{WDI} ", the clock pulse is ignored.

$$t_{WDI} (s) = t_{WD}/10$$

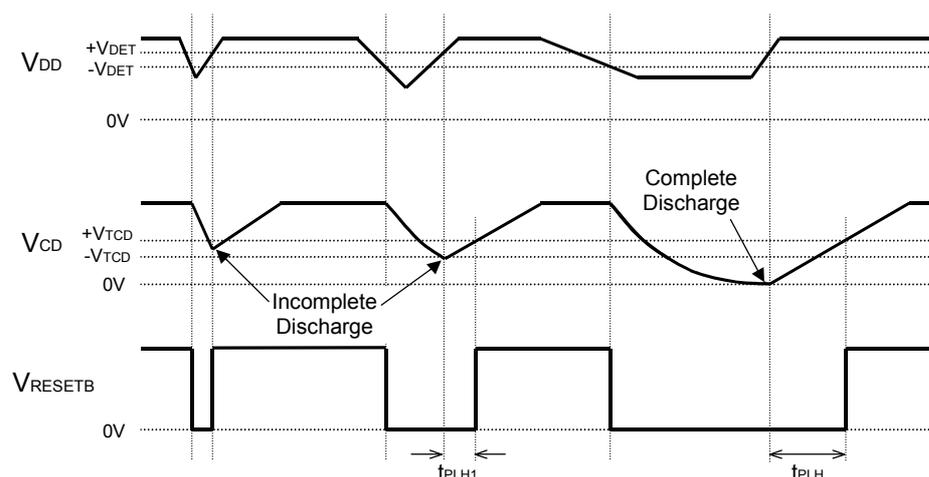
• Released Delay Time (Power-on Reset delay time)

The released delay time can be set with an external capacitor connected to the C_D pin. The next equation describes the relation between the capacitance value and the released delay time (t_{PLH}).

$$t_{PLH} (s) = 3.7 \times 10^6 \times C (F)$$

When the V_{DD} voltage becomes equal or less than ($-V_{DET}$), discharge of the capacitor connected to the C_D pin starts. Therefore, if the discharge is not enough and V_{DD} voltage returns to ($+V_{DET}$) or more, thereafter the delay time will be shorter than t_{PLH} which is expected.

Power on Reset Operation against the input glitch ($t_{PLH1} < t_{PLH}$)



• Minimum Operating Voltage

We specified the minimum operating voltage as the minimum input voltage in which the condition of RESETB pin being $0.1V$ or lower than $0.1V$. (Herein, pull-up resistance is set as $100k\Omega$ in the case of the Nch open-drain output type.)

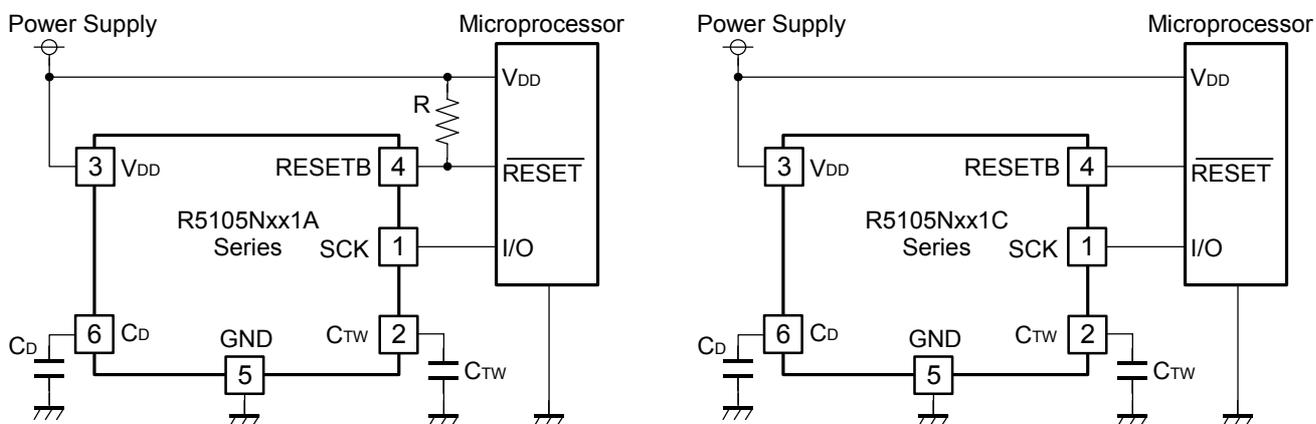
- **RESETB Output**

RESETB pin's output type is selectable either the Nch open-drain output or CMOS output. If the Nch open-drain type output is selected, the RESETB pin is pulled up with an external resistor to an appropriate voltage source.

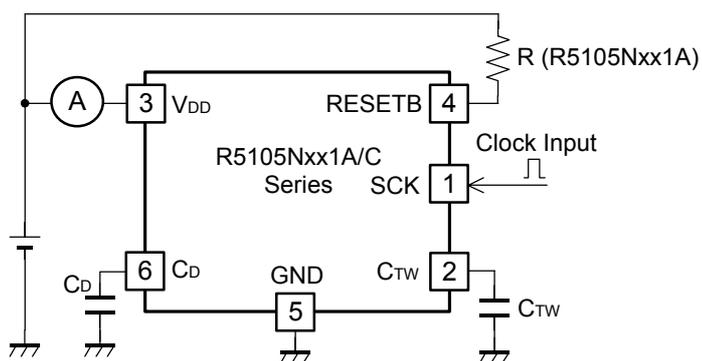
- **Clock Pulse Input**

Built-in watchdog timer is cleared with the SCK clock pulse within the watchdog timeout period.

TYPICAL APPLICATIONS



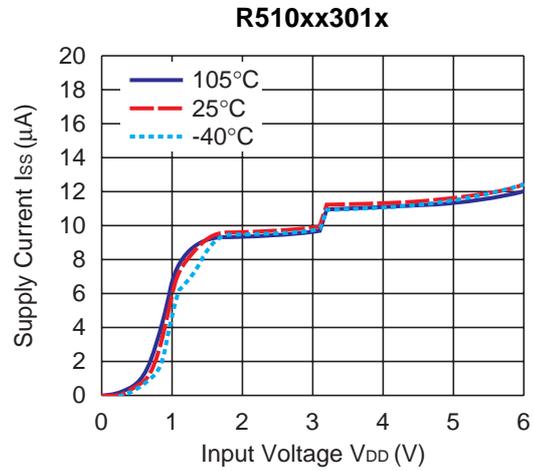
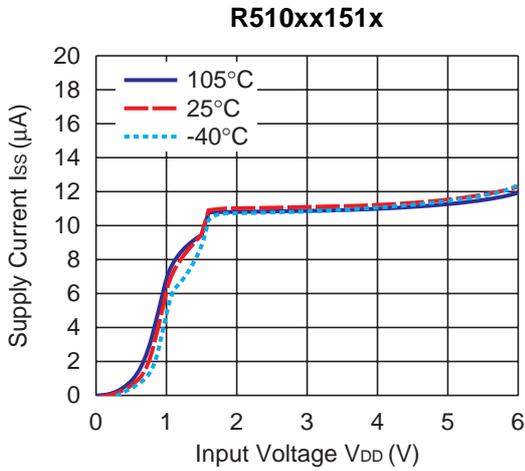
TEST CIRCUITS



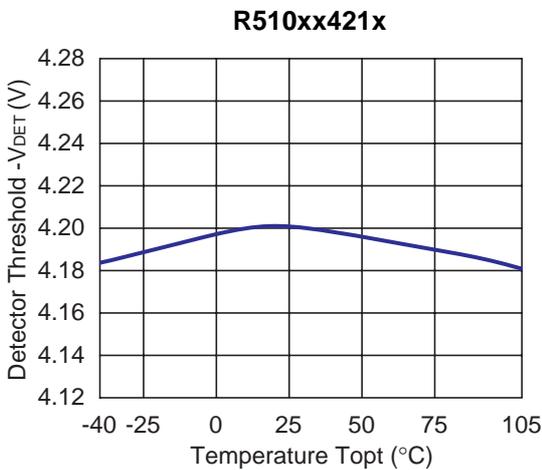
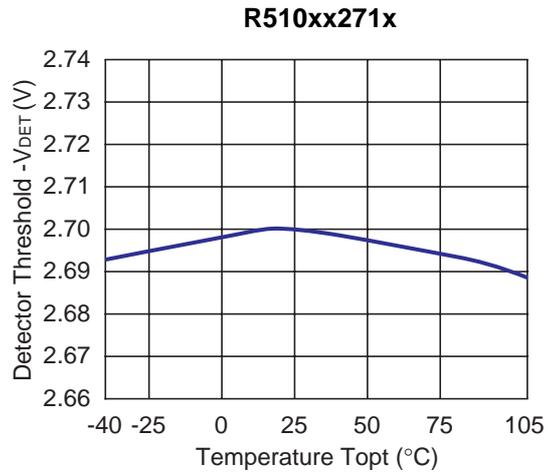
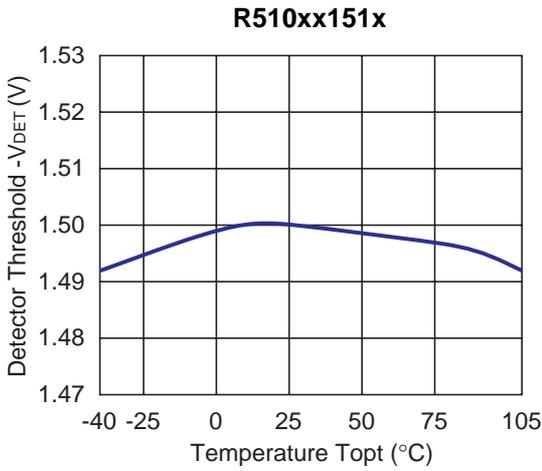
Supply Current Test Circuit

TYPICAL CHARACTERISTICS

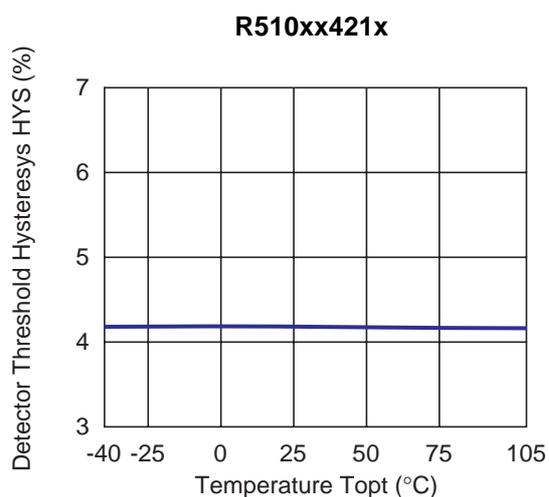
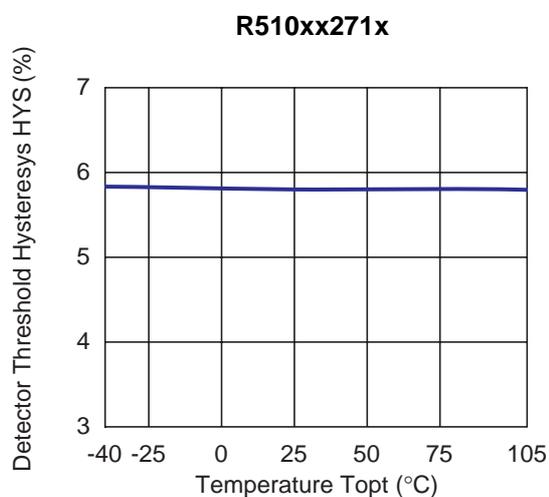
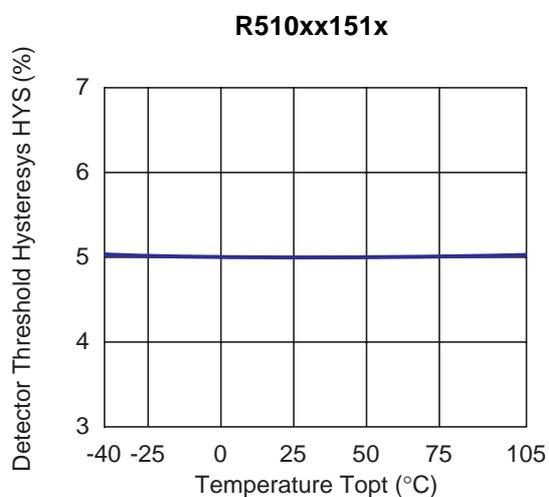
1) Supply Current vs. Input Voltage



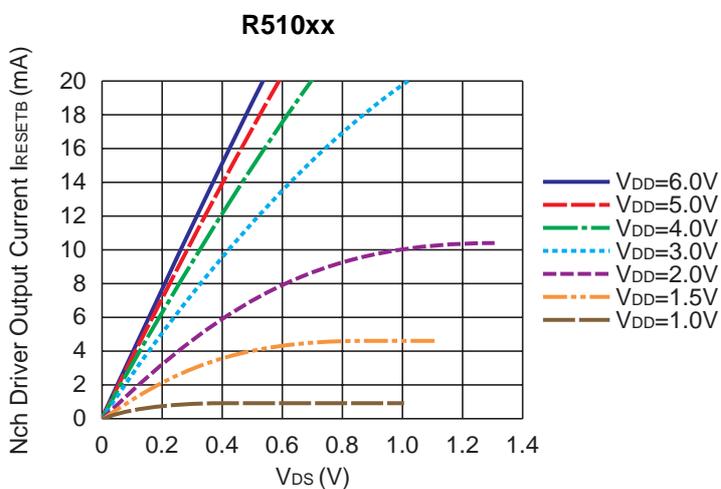
2) Detector Threshold vs. Temperature



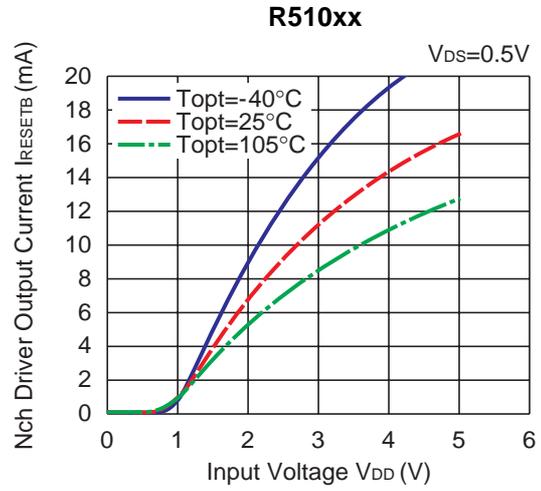
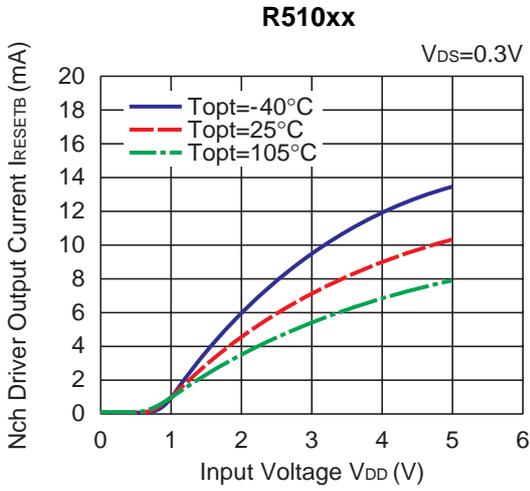
3) Detector Threshold Hysteresis vs. Temperature



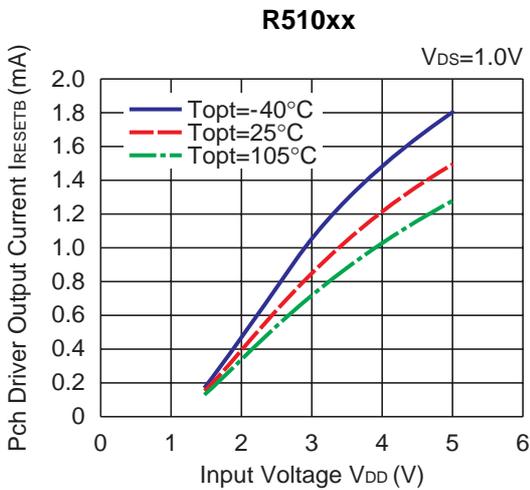
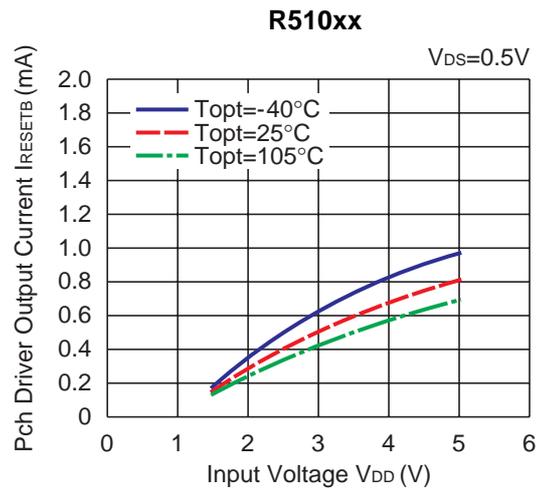
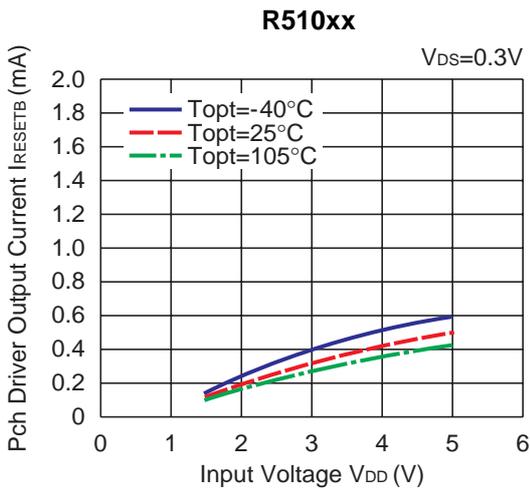
4) Nch Driver Output Current vs. Vds



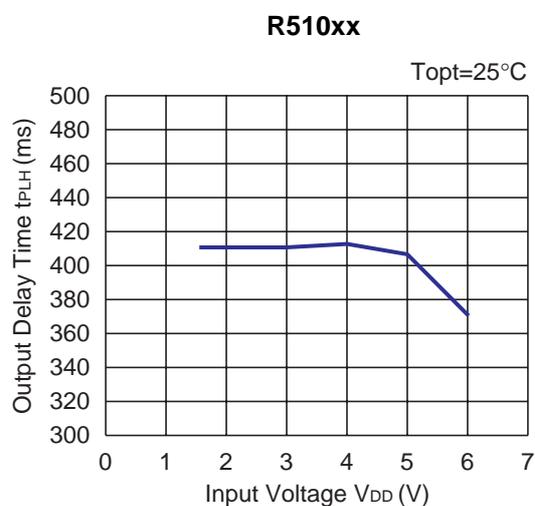
5) Nch Driver Output Current vs. Input Voltage



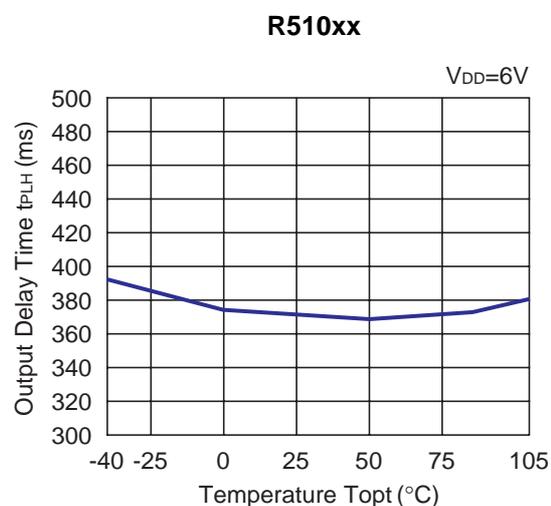
6) Pch Driver Output Current vs. Input Voltage



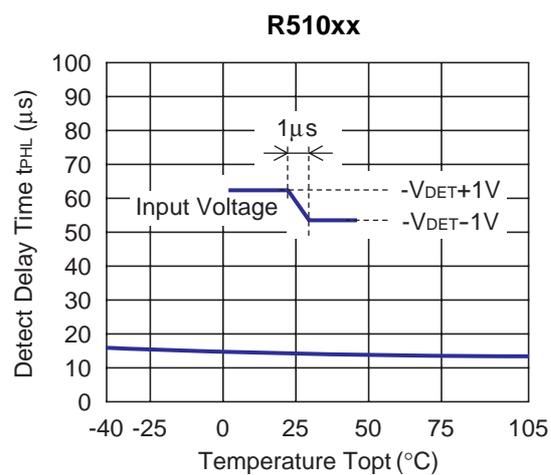
7) Released Delay Time vs. Input Voltage



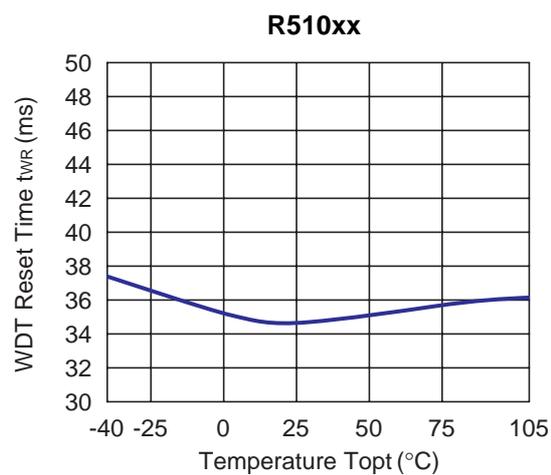
8) Released Delay Time vs. Temperature



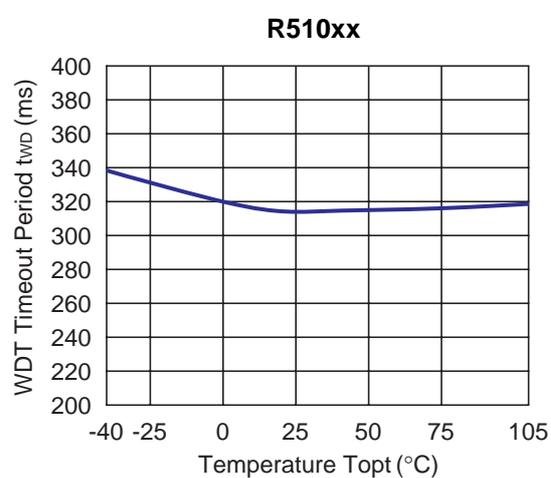
9) Detector Output Delay Time vs. Temperature



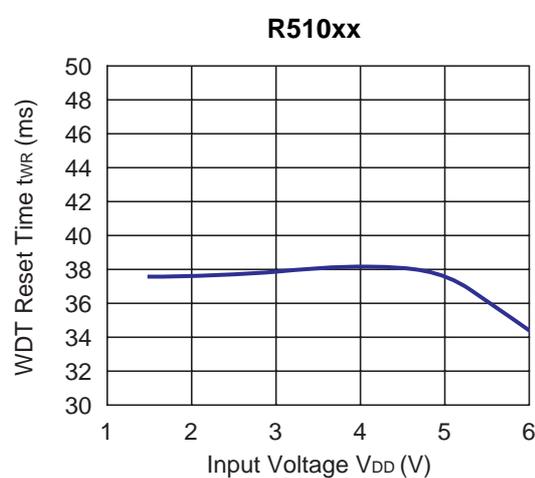
10) WDT Reset Timer vs. Temperature



11) WDT Timeout Period vs. Temperature

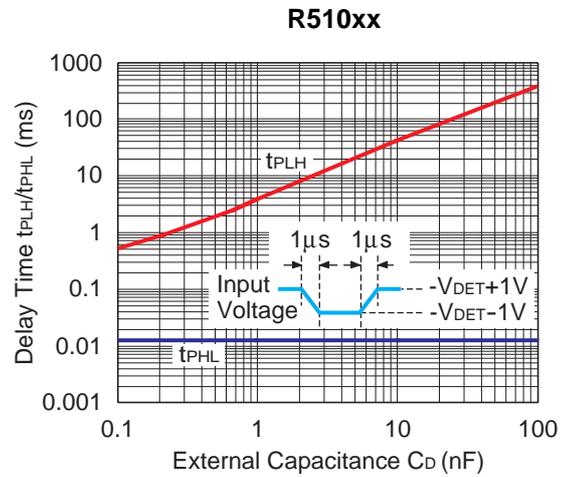
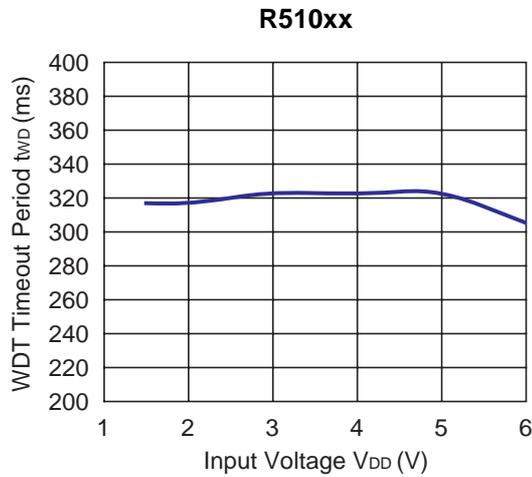


12) WDT Reset Timer vs. Input Voltage



13) WDT Timeout Period vs. Input Voltage

14) Output Delay Time vs. External Capacitance



TECHNICAL NOTES

When R510xxxx1A (Nch Open Drain Output Type) is used in Figure A or Figure B, if impedance of Voltage Supply pin, V_{DD} and V_{DD} of this IC is large, detector threshold level would shift by voltage dropdown caused by the consumption current of the IC itself. Released voltage may also shift and delay time for start-up might be generated by this usage.

When R510xxxx1C (CMOS Output Type) is used in Figure A or Figure B, Output level could be unstable by cross conduction current which is generated at detector threshold level or at released voltage level, therefore, do not use this IC with the connection in Figure A or Figure B.

The connection in Figure C may cause the oscillation in both R510xxxx1A (Nch Open Drain Output) and R510xxxx1C (CMOS Output), therefore do not use R510xx Series with the connection in Figure C.

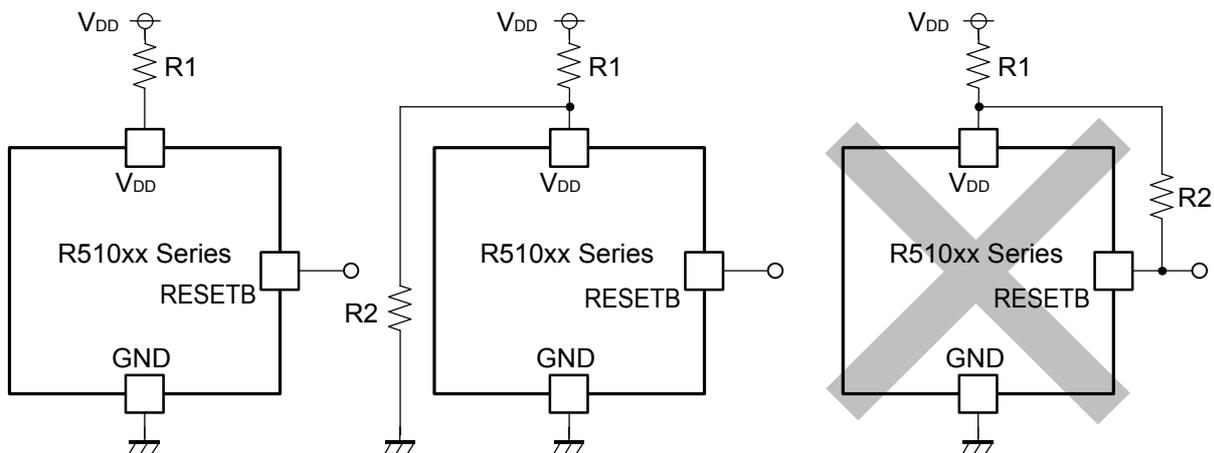


Figure A

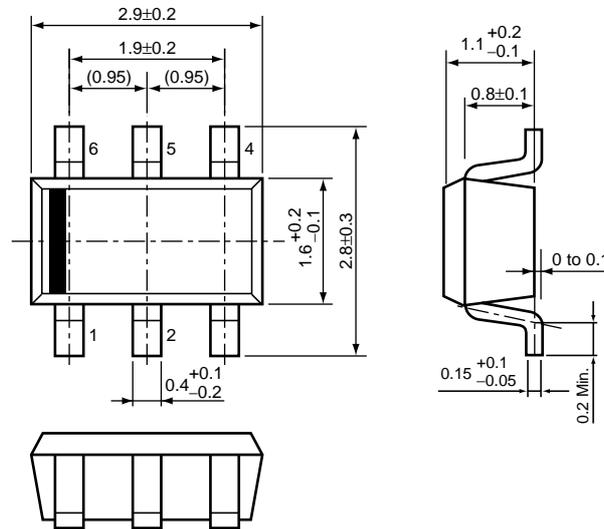
Figure B

Figure C

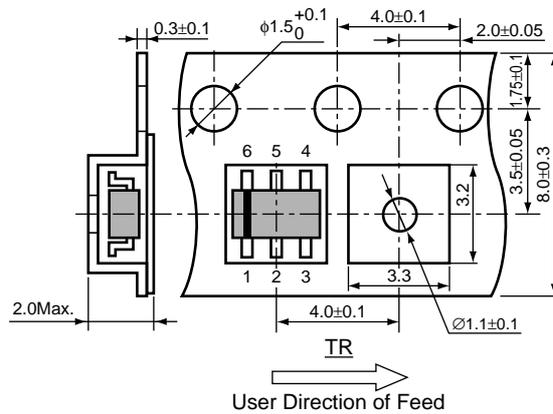
- SOT-23-6 (SC-74)

Unit: mm

PACKAGE DIMENSIONS

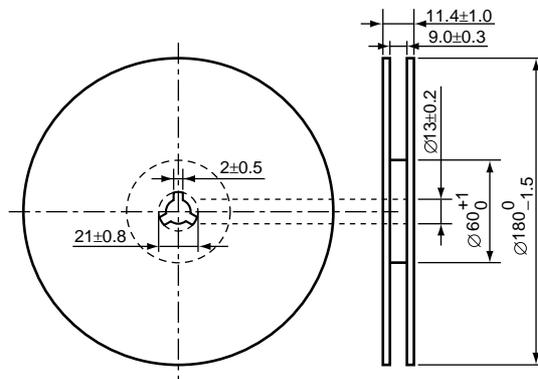


TAPING SPECIFICATION



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

(1reel=3000pcs)



POWER DISSIPATION (SOT-23-6)

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:

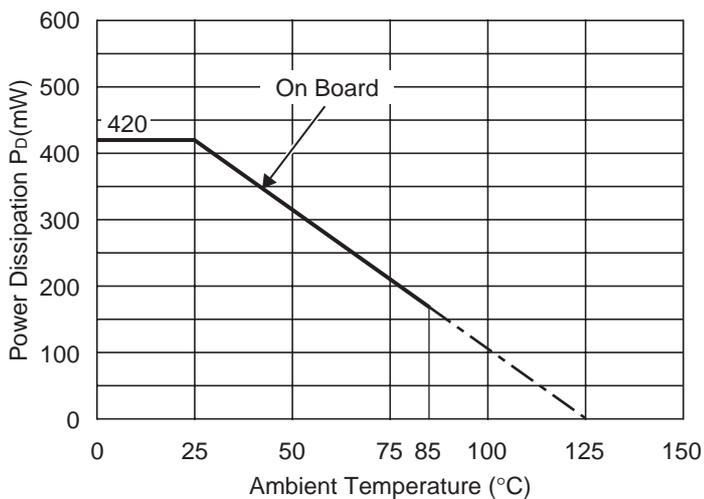
Measurement Conditions

	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

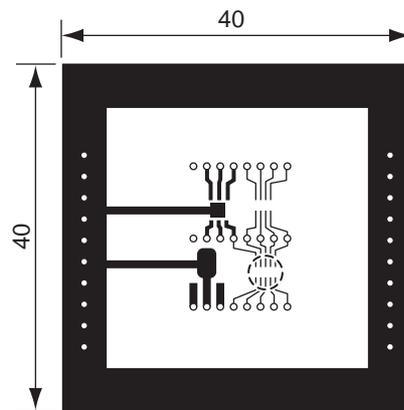
Measurement Result

($T_{opt}=25^{\circ}C, T_{jmax}=125^{\circ}C$)

	Standard Land Pattern	Free Air
Power Dissipation	420mW	250mW
Thermal Resistance	$\theta_{ja}=(125-25^{\circ}C)/0.42W=263^{\circ}C/W$	400°C/W



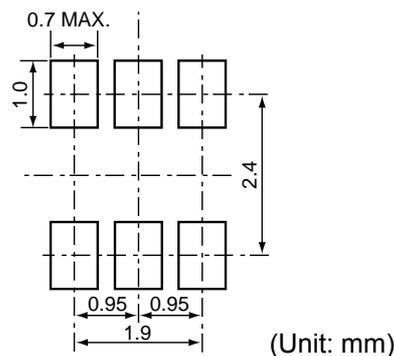
Power Dissipation



Measurement Board Pattern

○ IC Mount Area Unit : mm

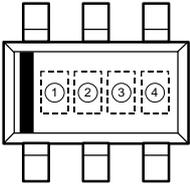
RECOMMENDED LAND PATTERN



(Unit: mm)

R5105N SERIES MARK SPECIFICATION

- SOT-23-6 (SC-74)



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

③, ④ : Lot Number

- Part Number vs. Product Code

R5105Nxx1A Series

Part Number	Product Code	
	①	②
R5105N151A	1	A
R5105N161A	1	B
R5105N171A	1	C
R5105N181A	1	D
R5105N191A	1	E
R5105N201A	1	F
R5105N211A	1	G
R5105N221A	1	H
R5105N231A	1	J
R5105N241A	1	K
R5105N251A	1	L
R5105N261A	1	M
R5105N271A	1	N
R5105N281A	1	P
R5105N291A	1	Q
R5105N301A	1	R
R5105N311A	1	S
R5105N321A	1	T
R5105N331A	1	U
R5105N341A	1	V
R5105N351A	1	W
R5105N361A	1	X
R5105N371A	1	Y
R5105N381A	1	Z

Part Number	Product Code	
	①	②
R5105N391A	2	A
R5105N401A	2	B
R5105N411A	2	C
R5105N421A	2	D
R5105N431A	2	E
R5105N441A	2	F
R5105N451A	2	G
R5105N461A	2	H
R5105N471A	2	J
R5105N481A	2	K
R5105N491A	2	L
R5105N501A	2	M
R5105N511A	2	N
R5105N521A	2	P
R5105N531A	2	Q
R5105N541A	2	R
R5105N551A	2	S

R5105Nxx1C Series

Part Number	Product Code	
	①	②
R5105N151C	3	A
R5105N161C	3	B
R5105N171C	3	C
R5105N181C	3	D
R5105N191C	3	E
R5105N201C	3	F
R5105N211C	3	G
R5105N221C	3	H
R5105N231C	3	J
R5105N241C	3	K
R5105N251C	3	L
R5105N261C	3	M
R5105N271C	3	N
R5105N281C	3	P
R5105N291C	3	Q
R5105N301C	3	R
R5105N311C	3	S
R5105N321C	3	T
R5105N331C	3	U
R5105N341C	3	V
R5105N351C	3	W
R5105N361C	3	X
R5105N371C	3	Y
R5105N381C	3	Z

Part Number	Product Code	
	①	②
R5105N391C	4	A
R5105N401C	4	B
R5105N411C	4	C
R5105N421C	4	D
R5105N431C	4	E
R5105N441C	4	F
R5105N451C	4	G
R5105N461C	4	H
R5105N471C	4	J
R5105N481C	4	K
R5105N491C	4	L
R5105N501C	4	M
R5105N511C	4	N
R5105N521C	4	P
R5105N531C	4	Q
R5105N541C	4	R
R5105N551C	4	S