RICOH

R5105N SERIES

Microprocessor Supervisory Circuit

NO.EA-159-160316

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 ±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 ±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 ±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. 11μA
- Operating Voltage Range ..... 0.9V to 6.0V

< Voltage Detector Part >

- Detector Threshold Range ..... 1.5V to 5.5V (0.1V steps)
- Detector Threshold Accuracy ..... ±1.0%
- Power-on Reset Delay Time accuracy ..... ±16%* (-40°C ≦ Topt ≦ 105°C)
- Power-on reset delay time of the voltage detector ..... Typ. 370ms with an external capacitor : 0.1μF

< Watchdog Timer Part >

- Built-in a watchdog timer's time out period accuracy ..... ±33%* (-40°C ≦ Topt ≦ 105°C)
- Timeout period for watchdog timer ..... Typ. 310ms with an external capacitor : 0.1μF
- Reset timer for watchdog timer ..... Typ. 34ms with an external capacitor : 0.1μF
- Package SOT-23-6

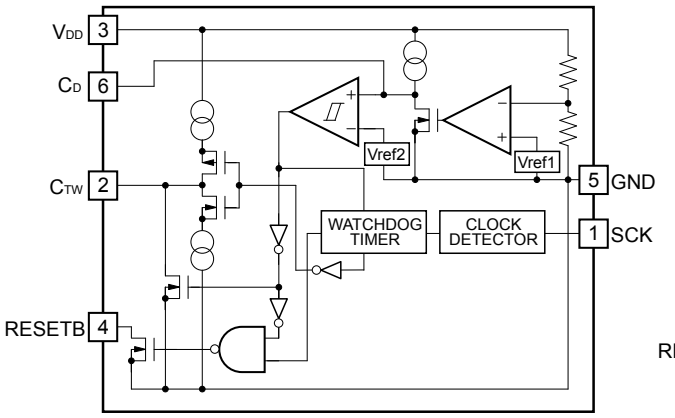
*) Accuracy to center value of (Min.+Max.)/2

APPLICATIONS

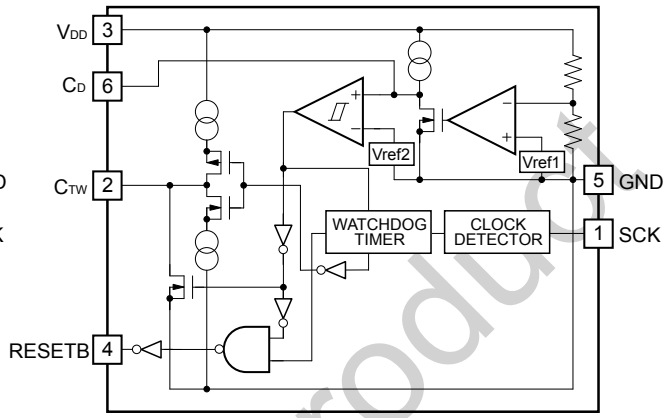
- Supervisory circuit for equipment with using microprocessors.

BLOCK DIAGRAMS

Nch Open Drain Output (R5105Nxx1A)



CMOS Output (R5105Nxx1C)



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;

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R5105Nxx1∗-TR-FE	SOT-23-6	3,000 pcs	Yes	Yes

xx: The detector threshold can be designated in the range from 1.5V(15) to 5.5V(55) in 0.1V steps.

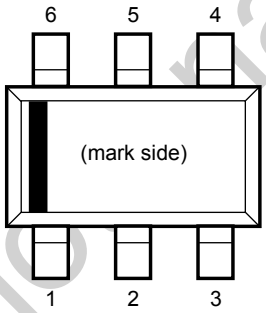
∗ : Designation of Output Type
(A) Nch Open Drain
(C) CMOS

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

- **SOT-23-6**



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 RATINGS

Topt=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
Topt	Operating Temperature Range		-40 to 105	°C
Tstg	Storage Temperature Range		-55 to 125	°C

*) For Power Dissipation, please refer to PACKAGE 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.

ELECTRICAL CHARACTERISTICS

V_{DD}=6.0V, C_{TW}=0.1μF, C_D=0.1μF, In case of Nch Open Drain Output type, the output pin is pulled up with a resistance of 100kΩ (R5105Nxx1A), unless otherwise noted.
The specification in ☐ is checked and guaranteed by design engineering at −40°C ≦ Topt ≦ 105°C.

- **R5105Nxx1A/C**

Topt=25°C

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

- **VD Part**

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
-V_{DET}	Detector Threshold	Topt=25°C		×0.990		×1.010	V
		−40°C ≦ Topt ≦ 105°C		×0.972		×1.015	
V_{HYS}	Detector Threshold Hysteresis			-V_{DET} ×0.03	-V_{DET} ×0.05	-V_{DET} ×0.07	V
Δ-V_{DET}/ ΔTopt	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 105°C			±100		ppm/°C
t_{PLH}	Output Delay Time	C_D=0.1μF *1		340	370	467	ms
I_{RESETB}	Output Current (RESETB Output pin)	Nch	V_{DD}=1.2V V_{DS}=0.1V	0.38	0.8		mA
		Pch *2	V_{DD}=6.0V V_{DS}=0.5V	0.65	0.9		mA

- **WDT Part**

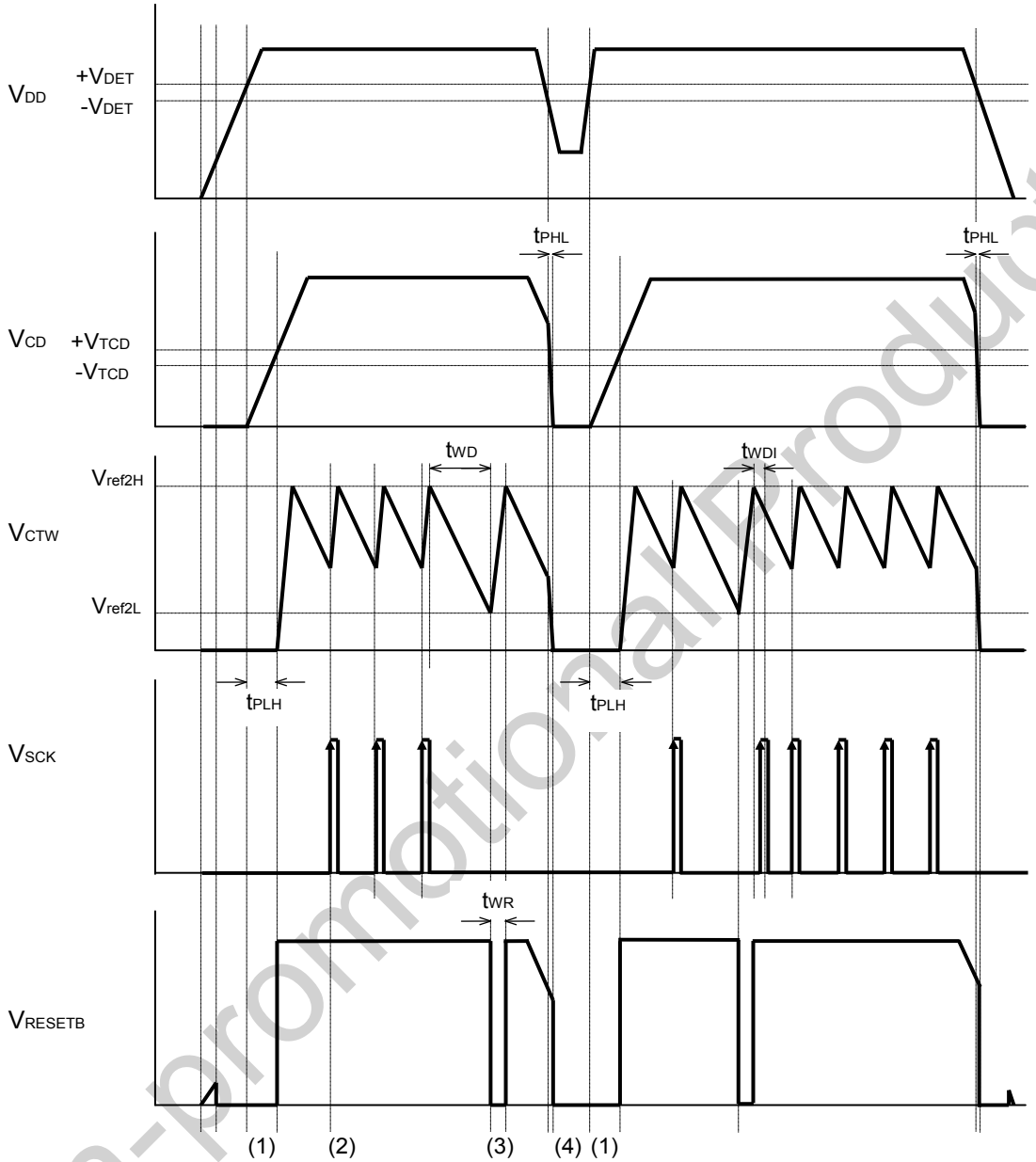
Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
t_{WD}	Watchdog Timeout period	C_{TW}=0.1μF *1	230	310	450	ms
t_{WR}	Reset Hold Time of WDT	C_{TW}=0.1μF *1	29	34	48	ms
V_{SCKH}	SCK Input "H"		V_{DD}×0.8		6.0	V
V_{SCKL}	SCK Input "L"		0		V_{DD}×0.2	V
t_{SCKW}	SCK Input Pulse Width	V_{SCKL}=V_{DD}×0.2 V_{SCKH}=V_{DD}×0.8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

All of unit are tested and specified under load conditions such that Topt=25°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".

During the reset time, (while charging the external capacitor) and 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) = $t_{WD}/10$

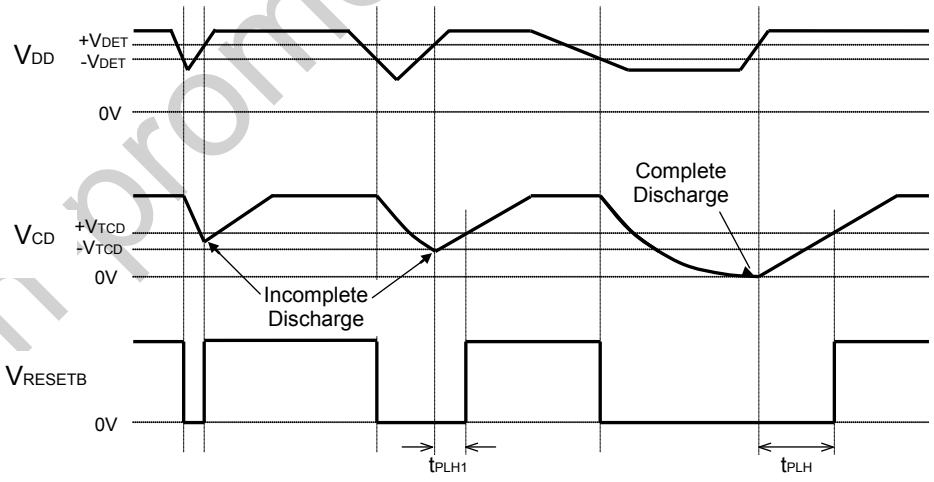
- **Released Delay Time (Power-on Reset delay time)**

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 100kΩ in the case of the Nch open-drain output type.)

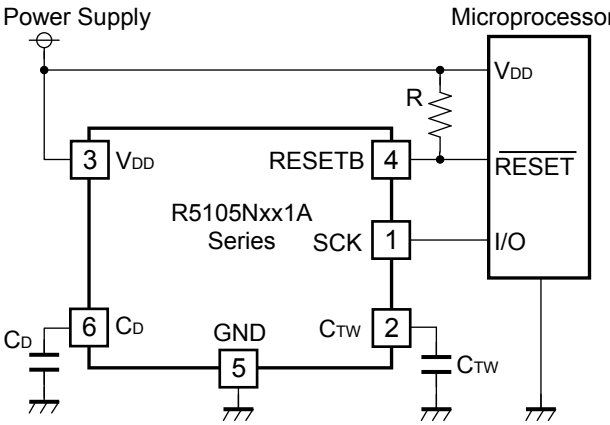
- **RESETB Output**

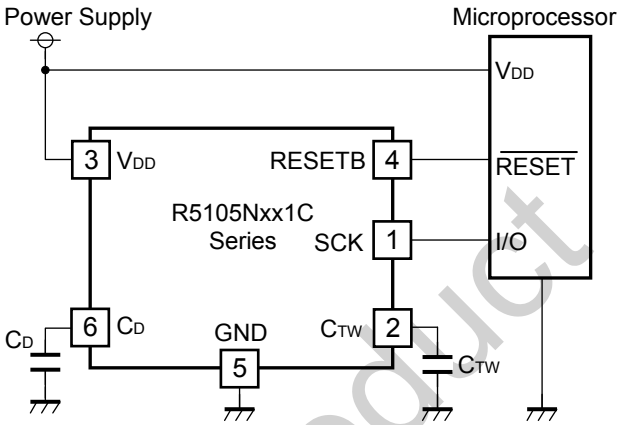
RESETB pin's output type is selectable either the Nch open-drain output or CMOS output. If the Nch open-drain type output is selected, the RESETB pin is pulled up with an external resistor to an appropriate voltage source.

- **Clock Pulse Input**

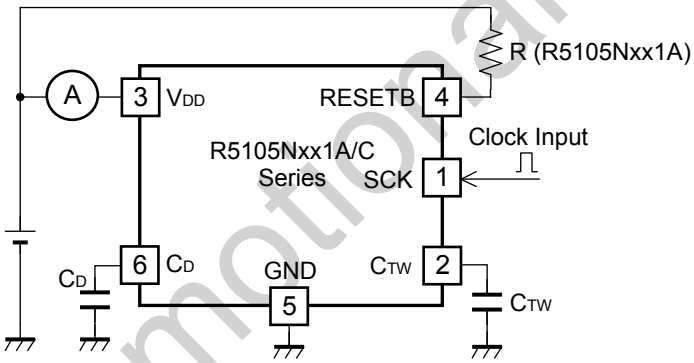
Built-in watchdog timer is cleared with the SCK clock pulse within the watchdog timeout period.

TYPICAL APPLICATIONS





TEST CIRCUITS

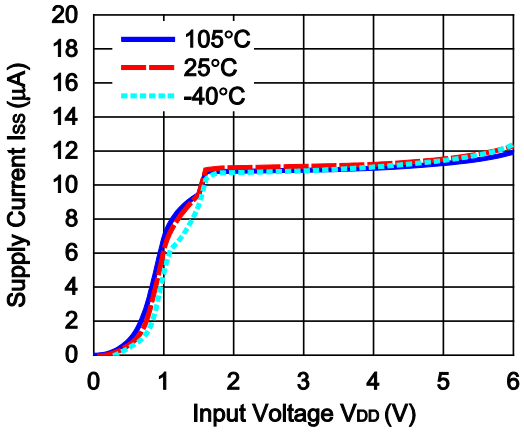


Supply Current Test Circuit

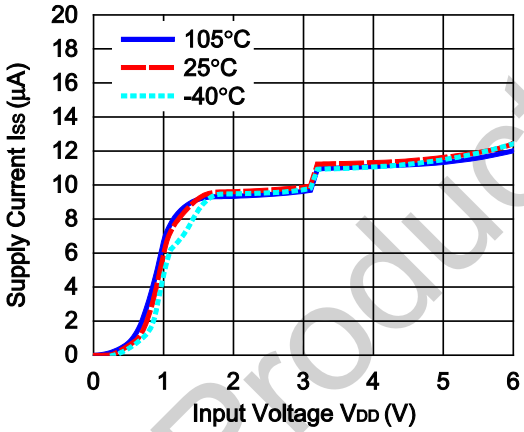
TYPICAL CHARACTERISTICS

1) Supply Current vs. Input Voltage

R510xx151x

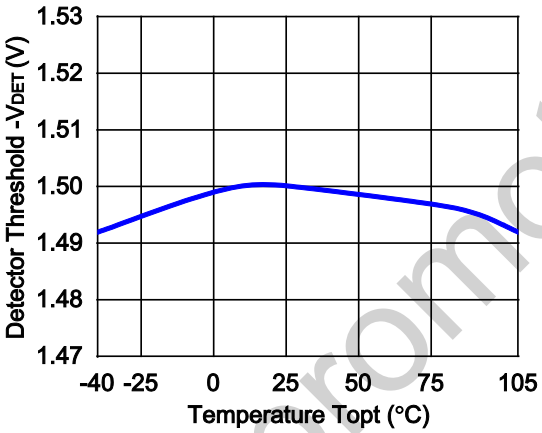


R510xx301x

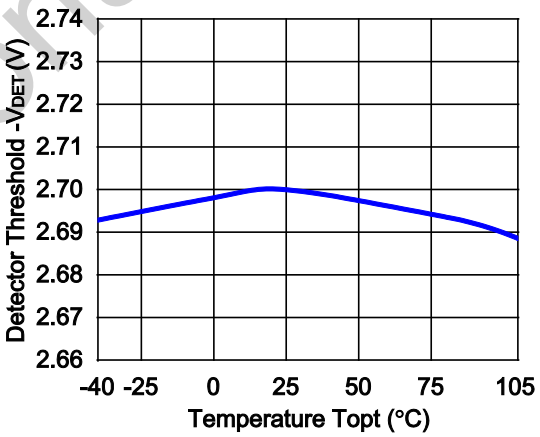


2) Detector Threshold vs. Temperature

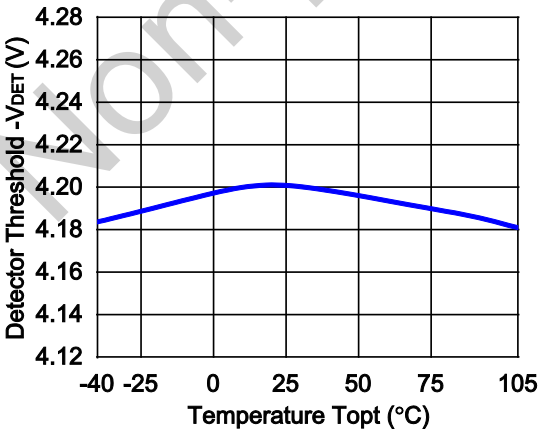
R510xx151x



R510xx271x

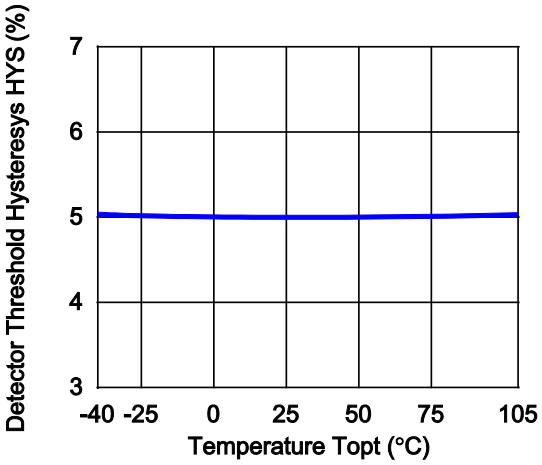


R510xx421x

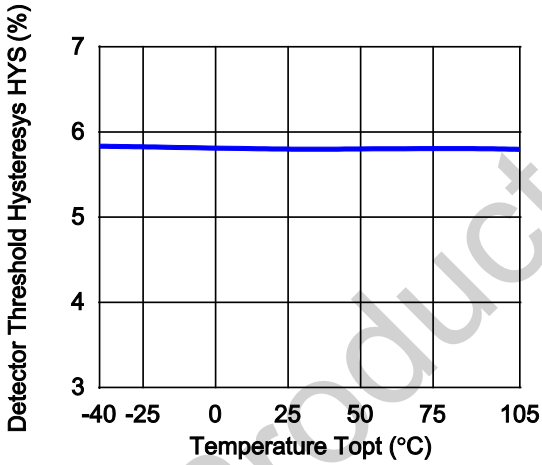


3) Detector Threshold Hysteresis vs. Temperature

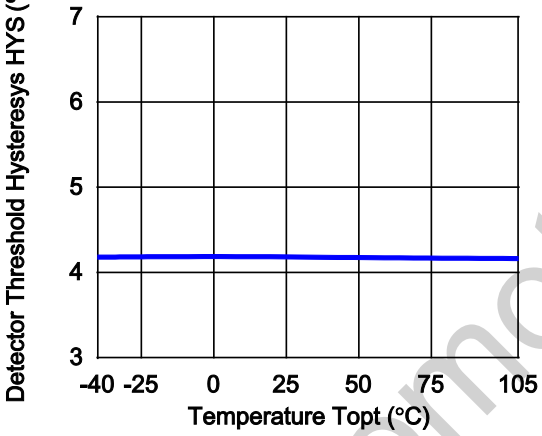
R510xx151x



R510xx271x

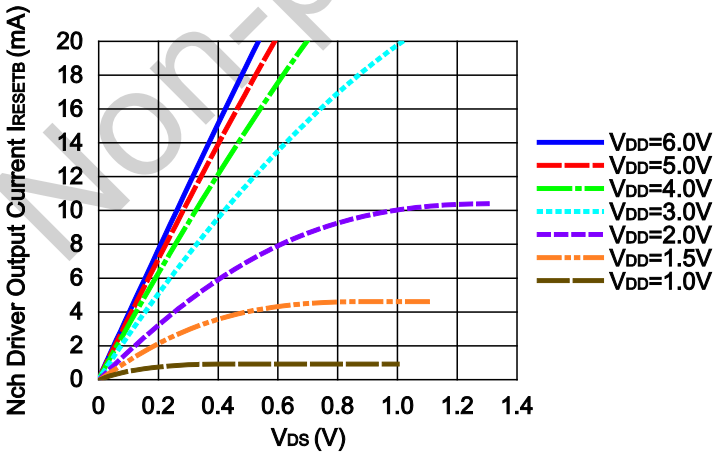


R510xx421x



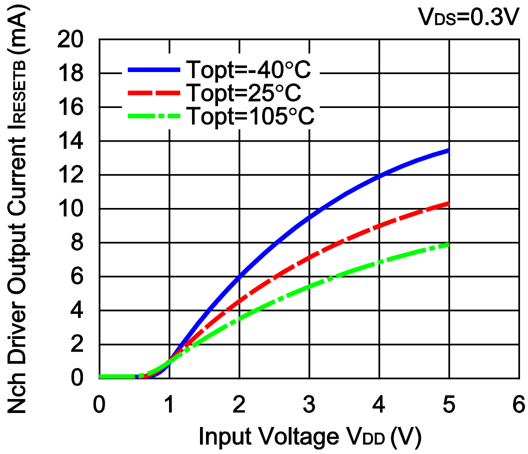
4) Nch Driver Output Current vs. V_{DS}

R510xx

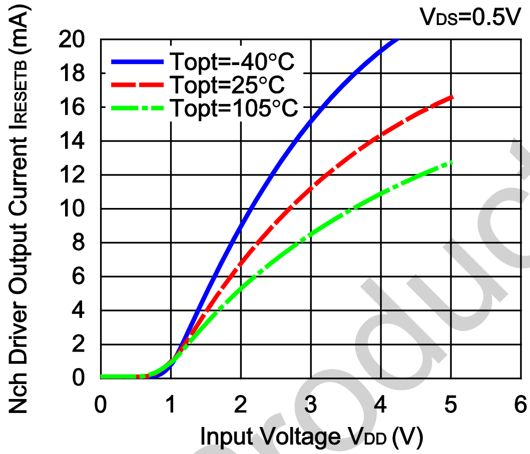


5) Nch Driver Output Current vs. Input Voltage

R510xx

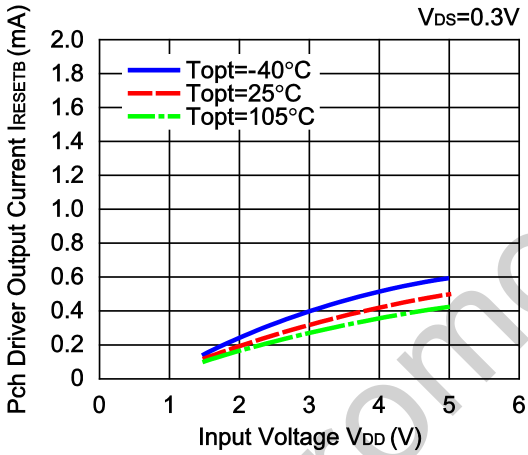


R510xx

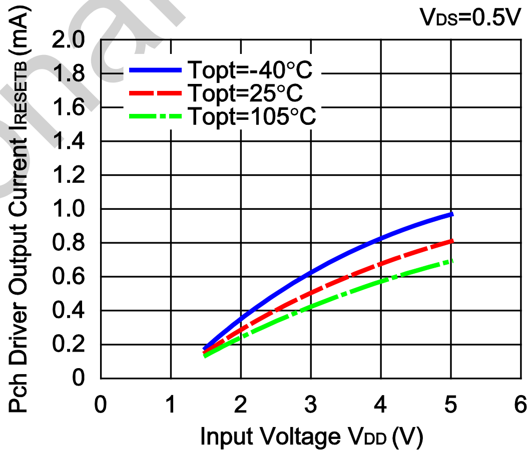


6) Pch Driver Output Current vs. Input Voltage

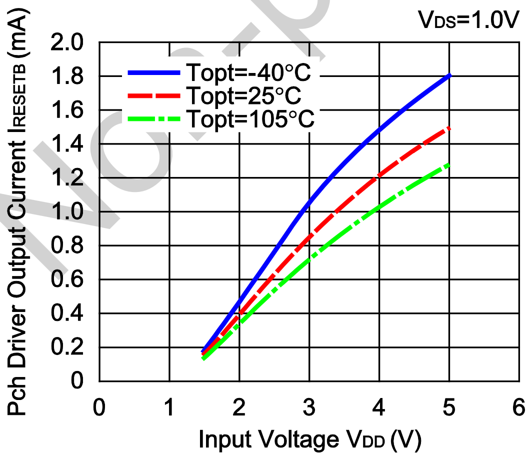
R510xx



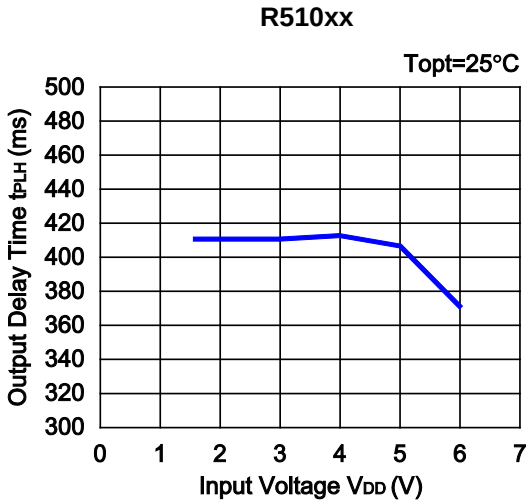
R510xx



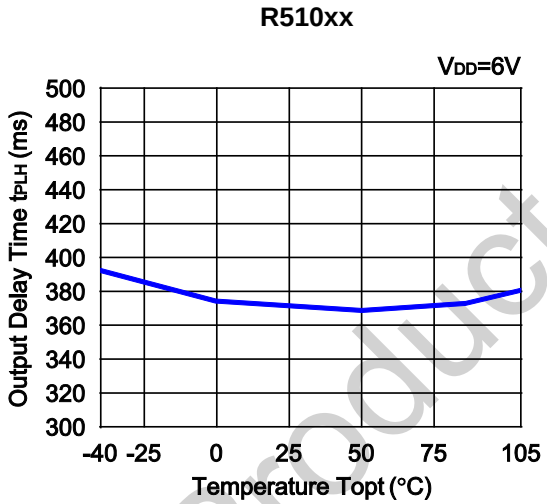
R510xx



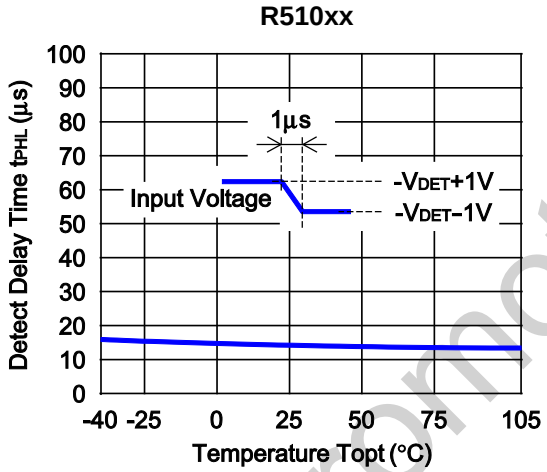
7) Released Delay Time vs. Input Voltage



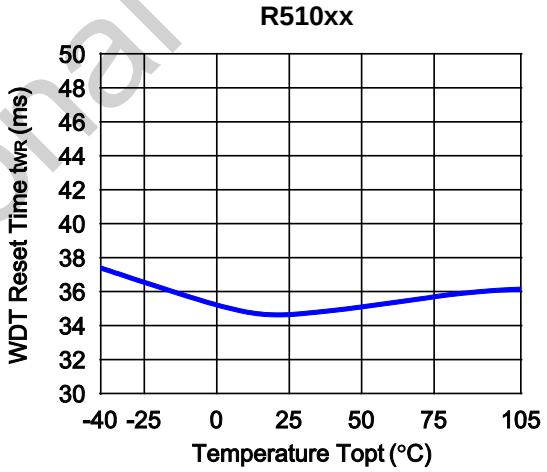
8) Released Delay Time vs. Temperature



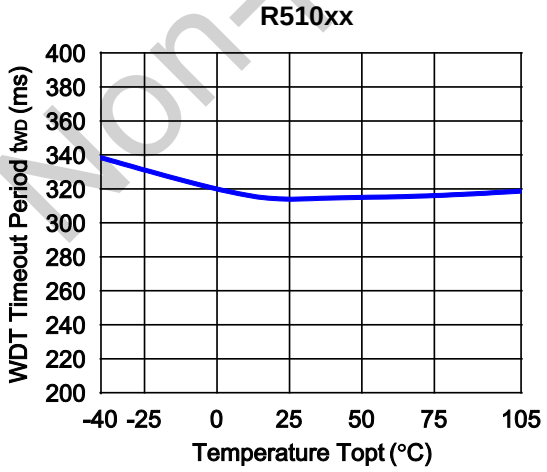
9) Detector Output Delay Time vs. Temperature



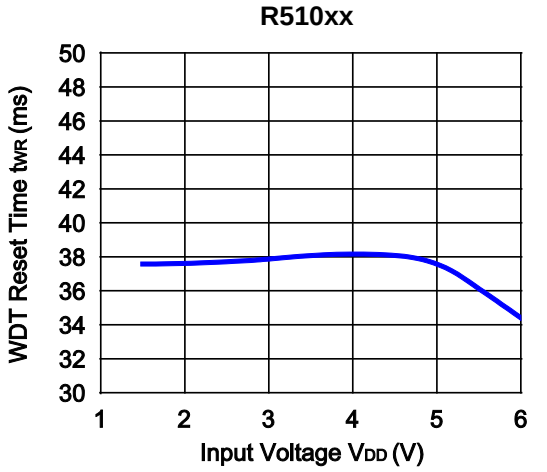
10) WDT Reset Timer vs. Temperature



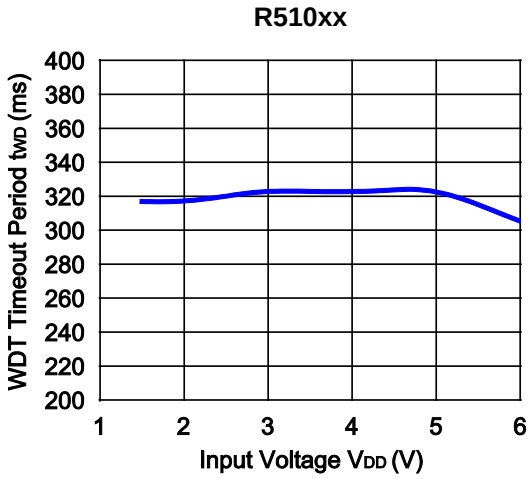
11) WDT Timeout Period vs. Temperature



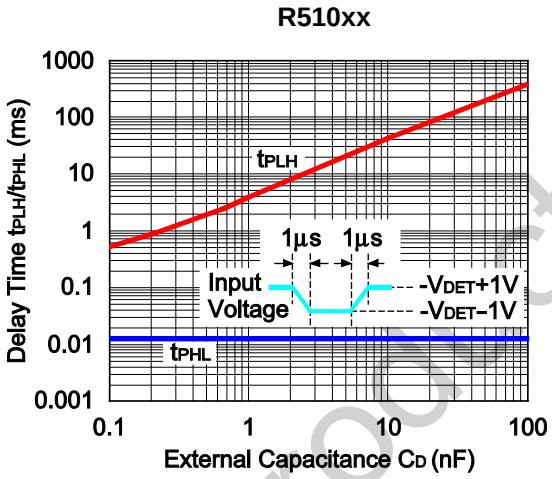
12) WDT Reset Timer vs. Input Voltage



13) WDT Timeout Period vs. Input Voltage



14) Output Delay Time vs. External Capacitance



TECHNICAL NOTES

When 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 100 kΩ or less as a guide, and connect C_{IN} of 0.1 µF 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 a result, make sure that the cross conduction current has no problem.

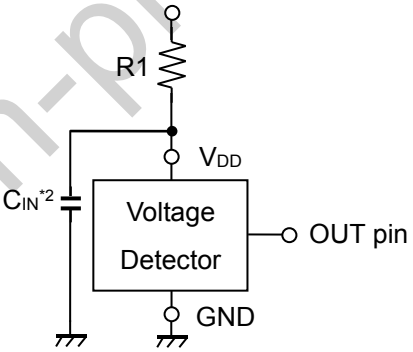


Figure A

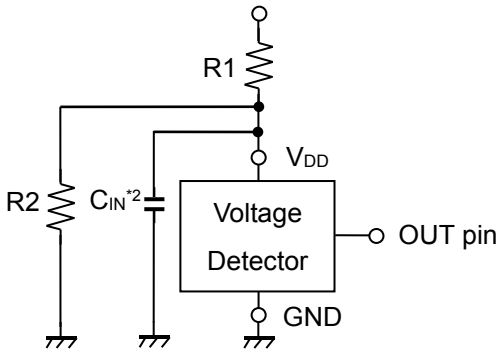


Figure B

*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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6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. Anti-radiation design is not implemented in the products described in this document.
8. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
9. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
10. There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact Ricoh sales or our distributor before attempting to use AOI.
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.
Ricoh has been providing RoHS compliant products since April 1, 2006 and Halogen-free products since April 1, 2012.

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