

## Microprocessor Supervisory Circuit

NO.EA-159-111103

### 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.  $11\mu\text{A}$
- 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.....  $\pm 1.0\%$
- 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 :  $0.1\mu\text{F}$

#### < Watchdog Timer Part >

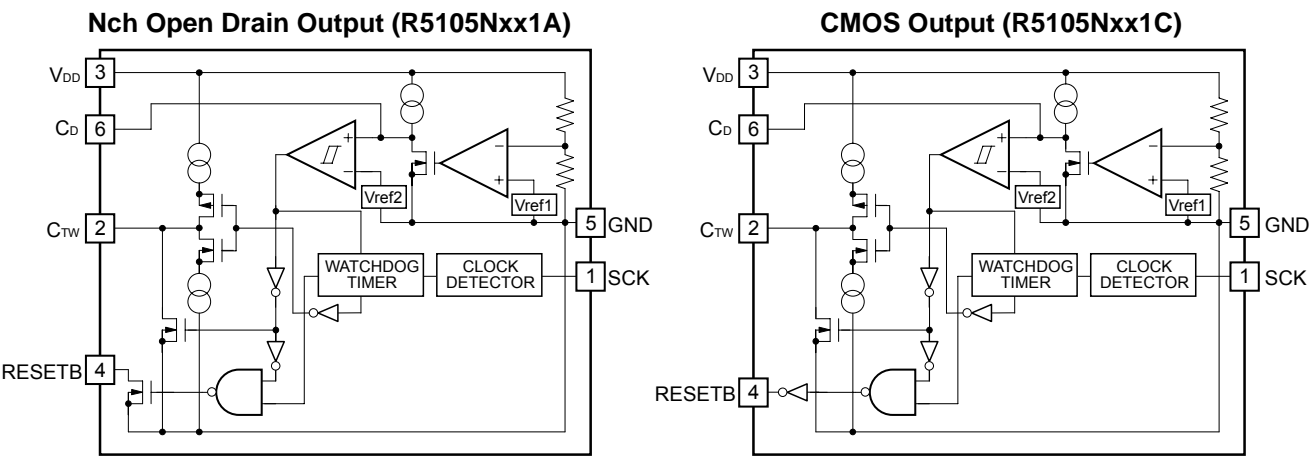
- Built-in a watchdog timer's time out period accuracy .....  $\pm 33\%^*$  ( $-40^\circ\text{C} \leq T_{\text{opt}} \leq 105^\circ\text{C}$ )
- Timeout period for watchdog timer ..... Typ. 310ms with an external capacitor :  $0.1\mu\text{F}$
- Reset timer for watchdog timer..... Typ. 34ms with an external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

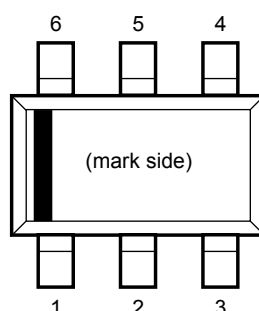
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R5105Nxx1*-TR-FE	SOT-23-6	3,000 pcs	Yes	Yes
xx: The detector threshold can be designated in the range from 1.5V(15) to 5.5V(55) in 0.1V steps.				
* : Designation of Output Type (A) Nch Open Drain (C) CMOS				

## 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 <sub>D</sub> pin and C <sub>TW</sub> 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**T<sub>opt</sub>=25°C

Symbol	Item		Rating	Unit
V <sub>DD</sub>	Supply Voltage		-0.3 to 7.0	V
V <sub>CD</sub>	Output Voltage	Voltage of C <sub>D</sub> Pin	-0.3 to V <sub>DD</sub> + 0.3	V
V <sub>CTW</sub>		Voltage of C <sub>TW</sub> Pin	-0.3 to V <sub>DD</sub> + 0.3	V
V <sub>RESETB</sub>		Voltage of RESETB Pin	-0.3 to 7.0	V
V <sub>SCK</sub>	Input Voltage	Voltage of SCK Pin	-0.3 to 7.0	V
I <sub>RESETB</sub>	Output Current	Current of RESETB Pin	20	mA
P <sub>D</sub>	Power Dissipation (SOT-23-6)*		420	mW
T <sub>opt</sub>	Operating Temperature Range		-40 to 105	°C
T <sub>stg</sub>	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

$V_{DD}=6.0V$ ,  $C_{TW}=0.1\mu F$ ,  $C_D=0.1\mu F$ , 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		<span style="border: 1px solid black; padding: 0 2px;">0.9</span>		<span style="border: 1px solid black; padding: 0 2px;">6.0</span>	V
$I_{SS}$	Supply Current	$V_{DD}=-V_{DET}+0.5V$ , Clock pulse input		11	<span style="border: 1px solid black; padding: 0 2px;">15</span>	$\mu A$

### • 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
		$-40^{\circ}C \leq T_{opt} \leq 105^{\circ}C$	<span style="border: 1px solid black; padding: 0 2px;"><math>\times 0.972</math></span>		<span style="border: 1px solid black; padding: 0 2px;"><math>\times 1.015</math></span>	
$V_{HYS}$	Detector Threshold Hysteresis		<span style="border: 1px solid black; padding: 0 2px;"><math>-V_{DET}</math> <math>\times 0.03</math></span>	$-V_{DET}$ $\times 0.05$	<span style="border: 1px solid black; padding: 0 2px;"><math>-V_{DET}</math> <math>\times 0.07</math></span>	V
$\Delta V_{DET}/\Delta T_{opt}$	Detector Threshold Temperature Coefficient	$-40^{\circ}C \leq T_{opt} \leq 105^{\circ}C$		$\pm 100$		ppm/ $^{\circ}C$
$t_{PLH}$	Output Delay Time	$C_D=0.1\mu F$ *1	<span style="border: 1px solid black; padding: 0 2px;">340</span>	370	<span style="border: 1px solid black; padding: 0 2px;">467</span>	ms
$I_{RESETB}$	Output Current (RESETB Output pin)	Nch $V_{DD}=1.2V$ $V_{DS}=0.1V$	<span style="border: 1px solid black; padding: 0 2px;">0.38</span>	0.8		mA
		Pch *2 $V_{DD}=6.0V$ $V_{DS}=0.5V$	<span style="border: 1px solid black; padding: 0 2px;">0.65</span>	0.9		mA

### • WDT Part

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$t_{WD}$	Watchdog Timeout period	$C_{TW}=0.1\mu F$ *1	<span style="border: 1px solid black; padding: 0 2px;">230</span>	310	<span style="border: 1px solid black; padding: 0 2px;">450</span>	ms
$t_{WR}$	Reset Hold Time of WDT	$C_{TW}=0.1\mu F$ *1	<span style="border: 1px solid black; padding: 0 2px;">29</span>	34	<span style="border: 1px solid black; padding: 0 2px;">48</span>	ms
$V_{SCKH}$	SCK Input "H"		<span style="border: 1px solid black; padding: 0 2px;"><math>V_{DD} \times 0.8</math></span>		<span style="border: 1px solid black; padding: 0 2px;">6.0</span>	V
$V_{SCKL}$	SCK Input "L"		<span style="border: 1px solid black; padding: 0 2px;">0</span>		<span style="border: 1px solid black; padding: 0 2px;"><math>V_{DD} \times 0.2</math></span>	V
$t_{SCKW}$	SCK Input Pulse Width	$V_{SCKL}=V_{DD} \times 0.2$ $V_{SCKH}=V_{DD} \times 0.8$	<span style="border: 1px solid black; padding: 0 2px;">500</span>			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)

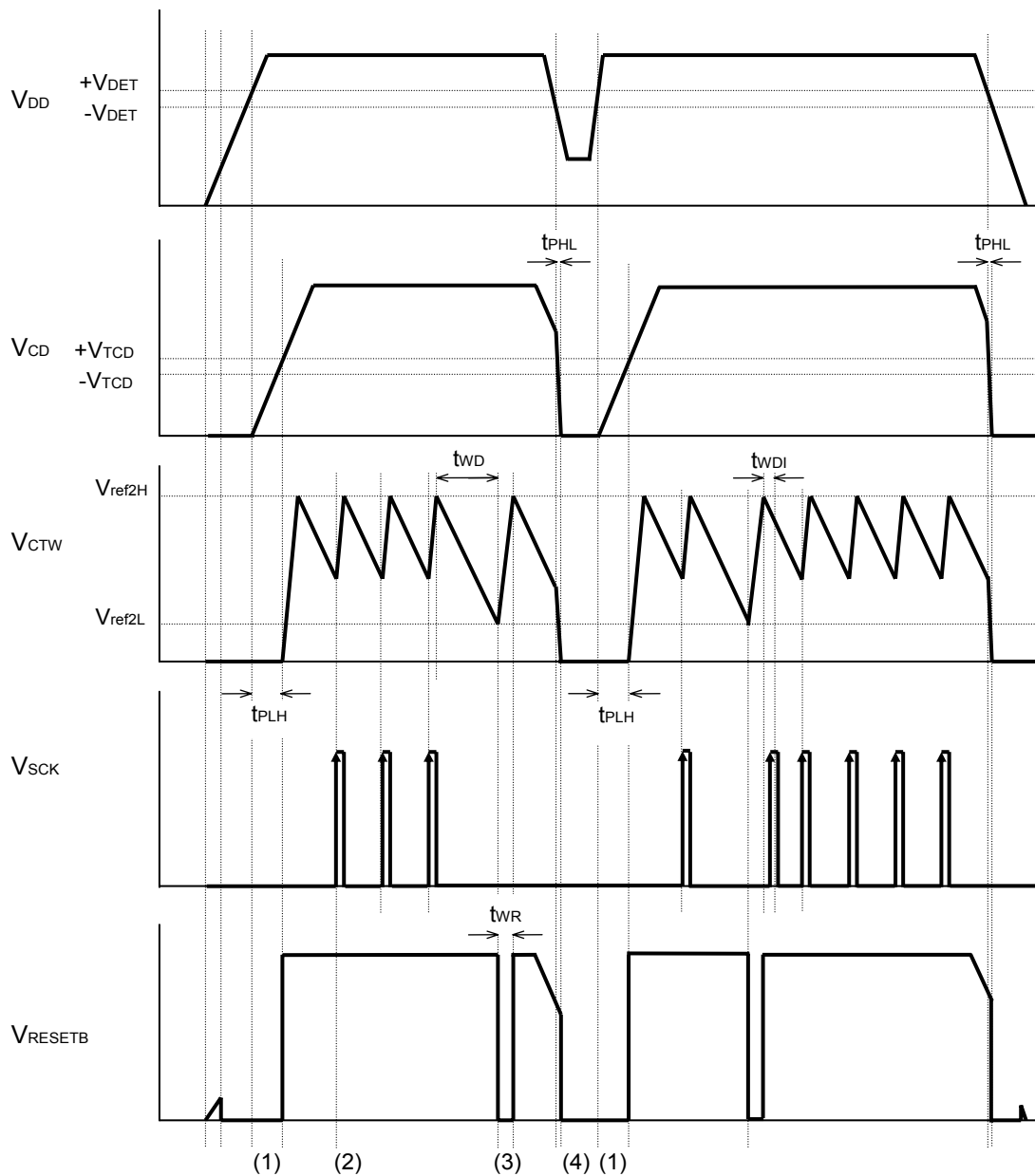
### RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

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<sub>TW</sub> 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<sub>WDI</sub>", the clock pulse is ignored.

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

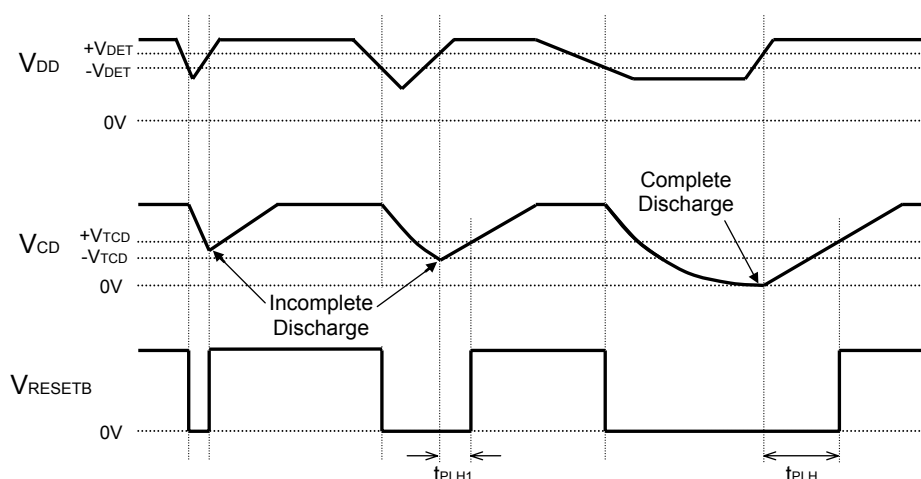
### • Released Delay Time (Power-on Reset delay time)

The released delay time can be set with an external capacitor connected to the C<sub>D</sub> pin. The next equation describes the relation between the capacitance value and the released delay time (t<sub>PLH</sub>).

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

When the V<sub>DD</sub> voltage becomes equal or less than (-V<sub>DET</sub>), discharge of the capacitor connected to the C<sub>D</sub> pin starts. Therefore, if the discharge is not enough and V<sub>DD</sub> voltage returns to (+V<sub>DET</sub>) or more, thereafter the delay time will be shorter than t<sub>PLH</sub> which is expected.

Power on Reset Operation against the input glitch (t<sub>PLH1</sub> < t<sub>PLH</sub>)



### • 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**

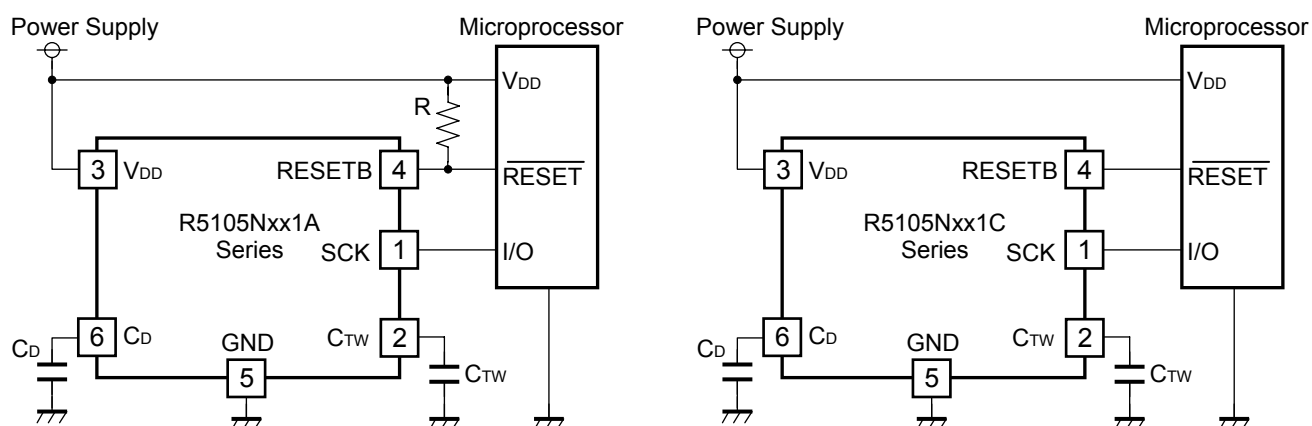
RESETB pin's output type is selectable either the Nch open-drain output or CMOS output. If the Nch open-drain type output is selected, the RESETB pin is pulled up with an external resistor to an appropriate voltage source.

- **Clock Pulse Input**

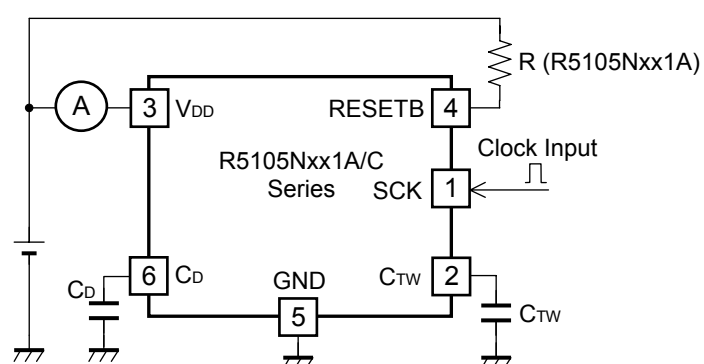
Built-in watchdog timer is cleared with the SCK clock pulse within the watchdog timeout period.



## TYPICAL APPLICATIONS



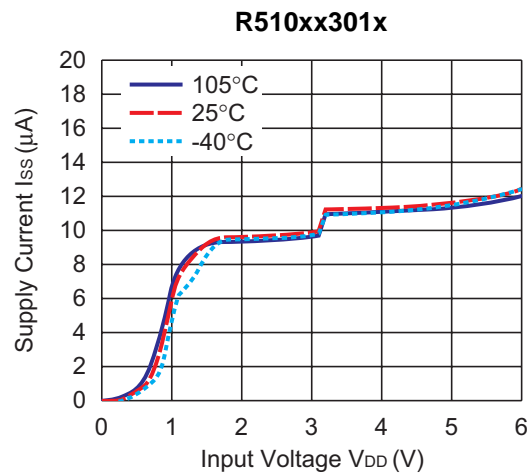
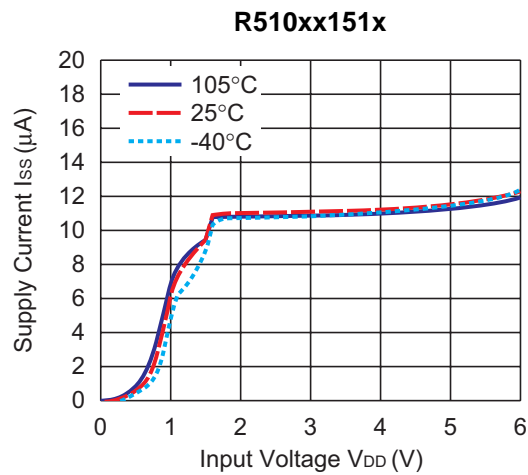
## TEST CIRCUITS



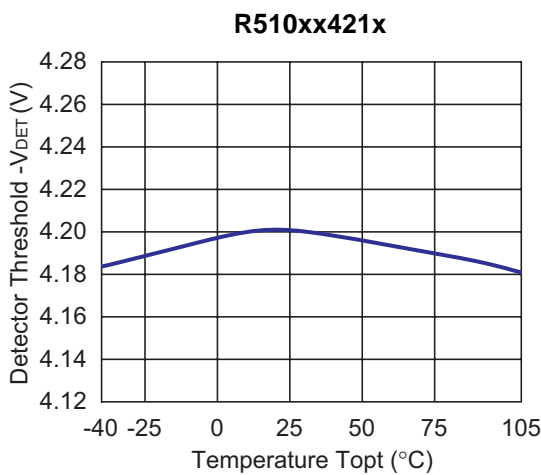
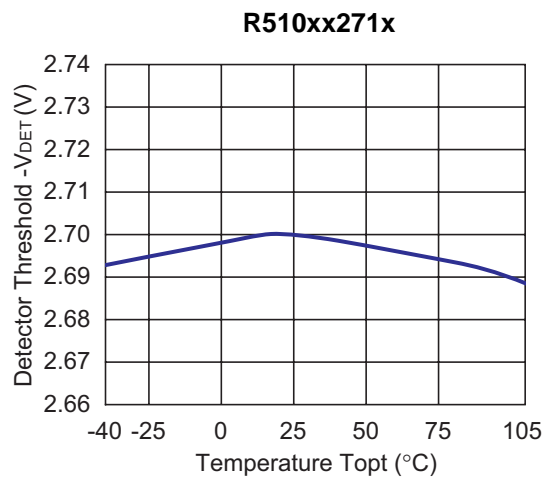
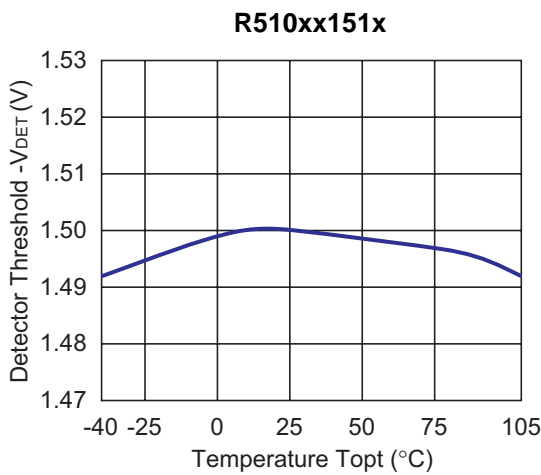
Supply Current Test Circuit

TYPICAL CHARACTERISTICS

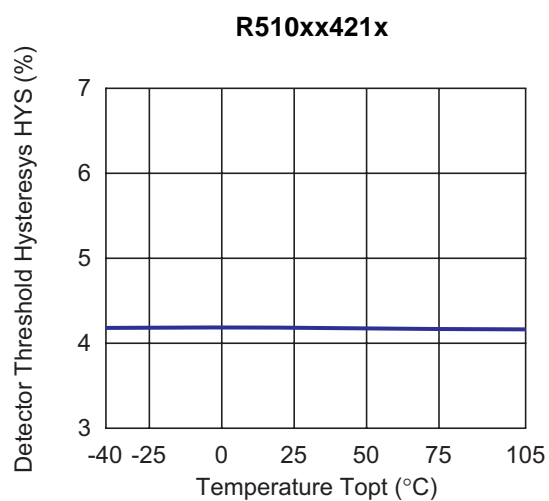
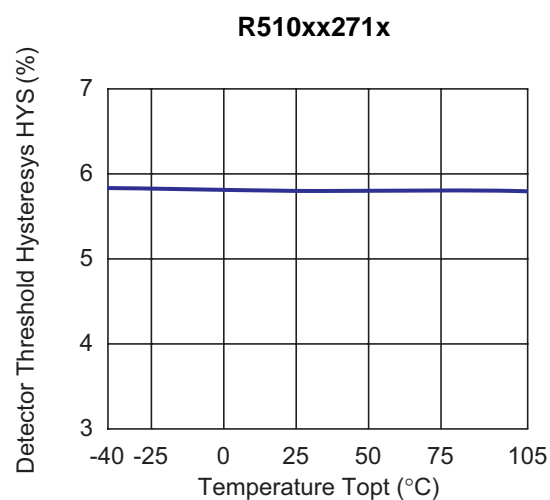
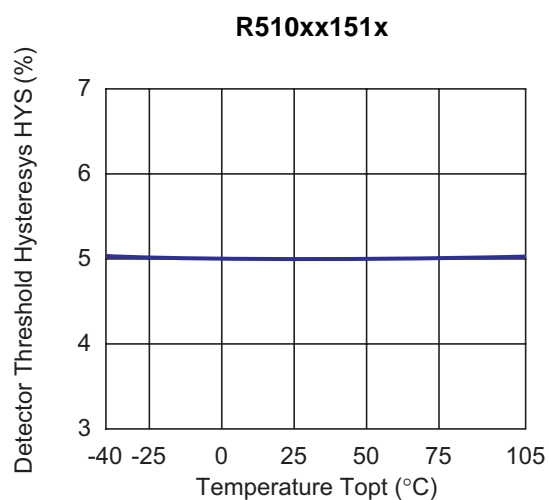
1) Supply Current vs. Input Voltage



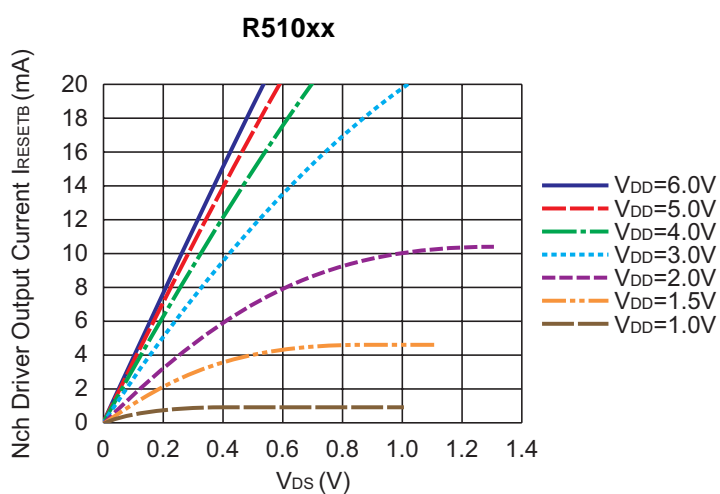
2) Detector Threshold vs. Temperature



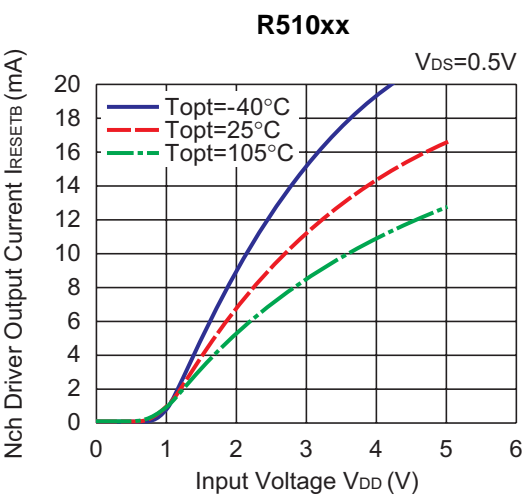
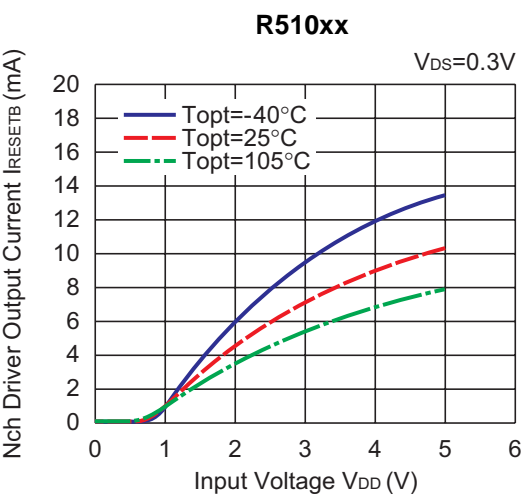
### 3) Detector Threshold Hysteresis vs. Temperature



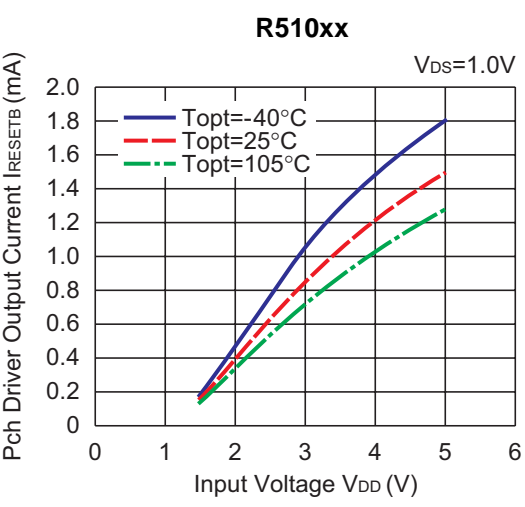
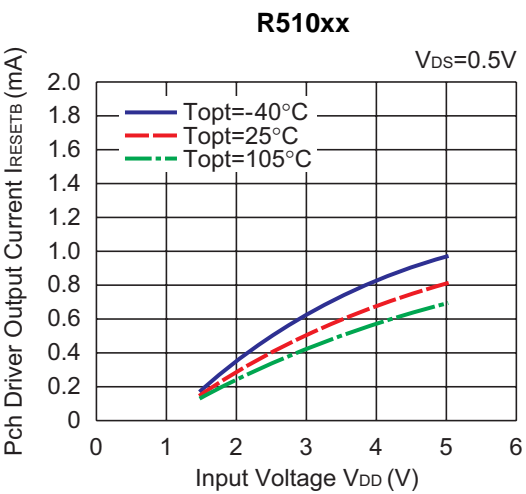
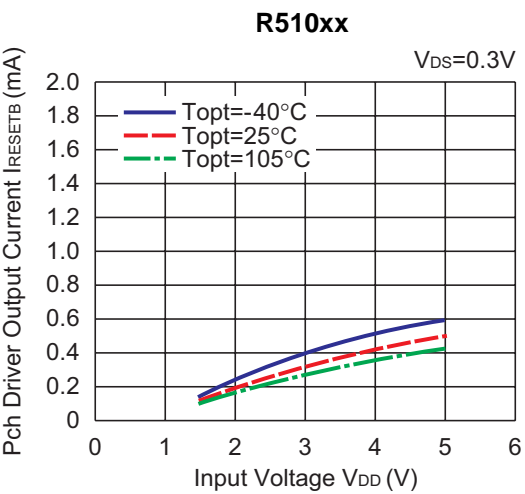
### 4) Nch Driver Output Current vs. V<sub>DS</sub>



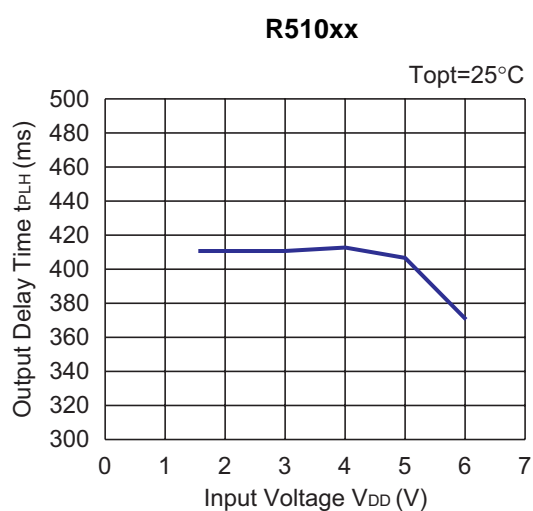
5) Nch Driver Output Current vs. Input Voltage



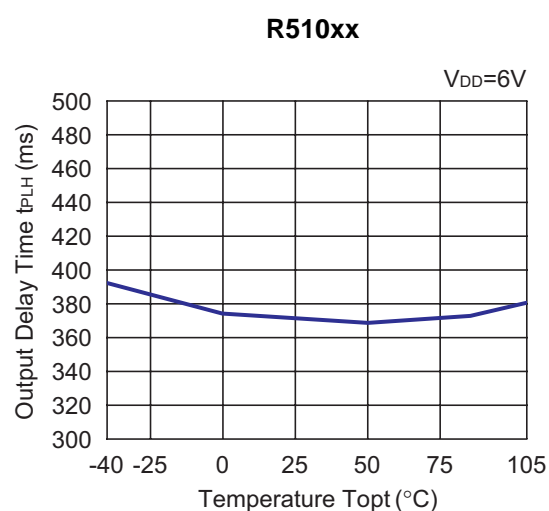
6) Pch Driver Output Current vs. Input Voltage



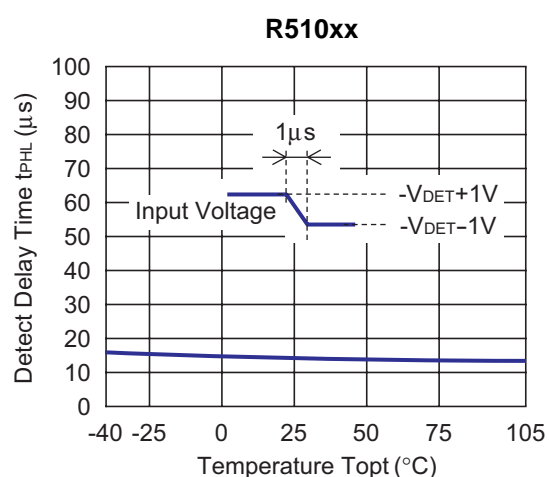
## 7) Released Delay Time vs. Input Voltage



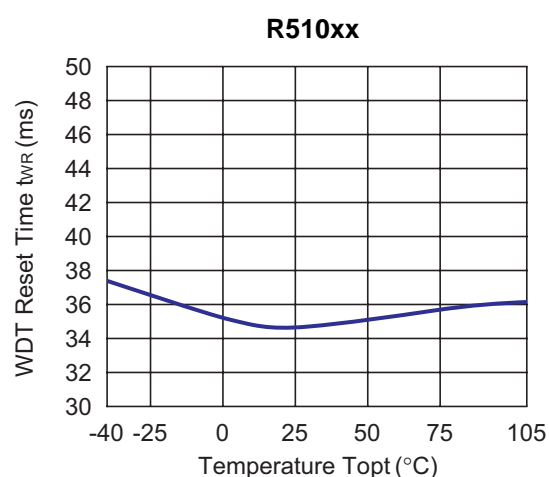
## 8) Released Delay Time vs. Temperature



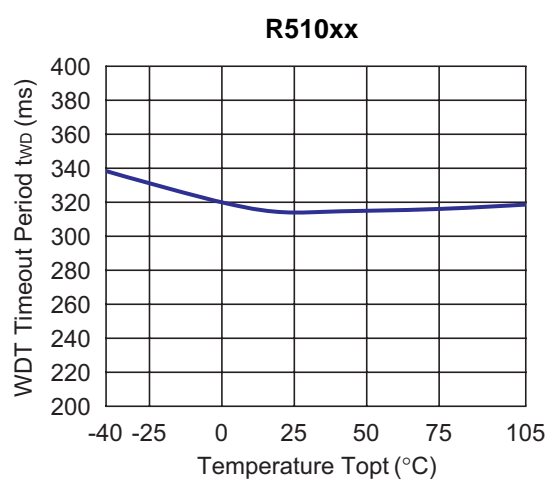
## 9) Detector Output Delay Time vs. Temperature



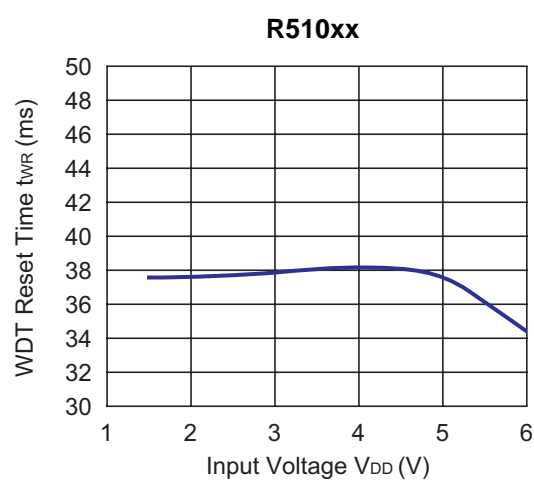
## 10) WDT Reset Timer vs. Temperature



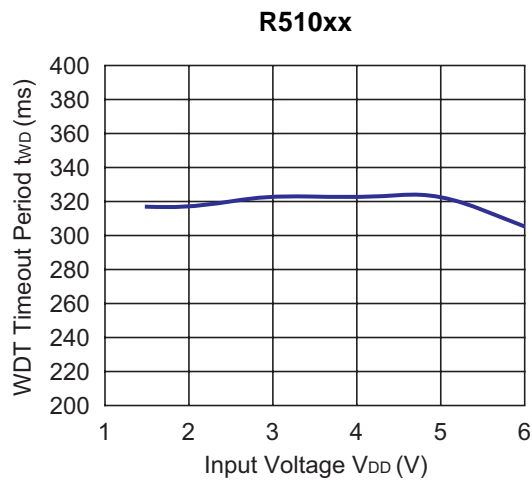
## 11) WDT Timeout Period vs. Temperature



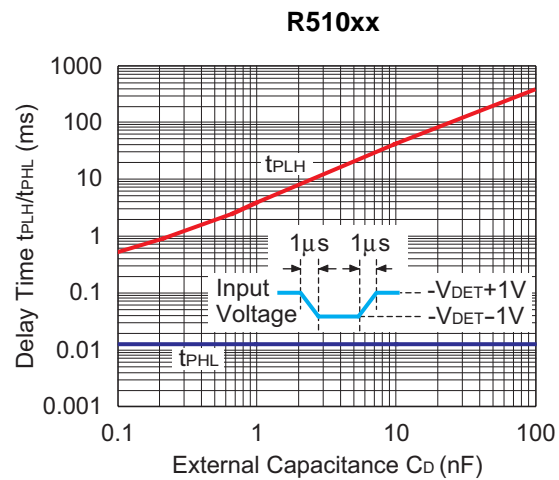
## 12) WDT Reset Timer vs. Input Voltage



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.

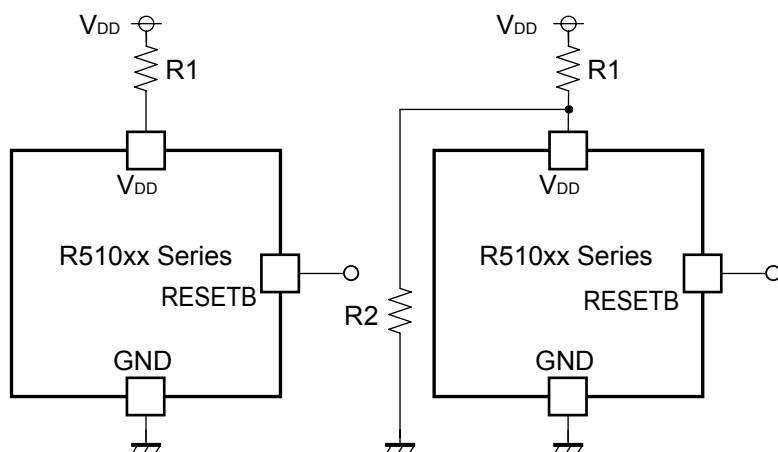


Figure A

Figure B

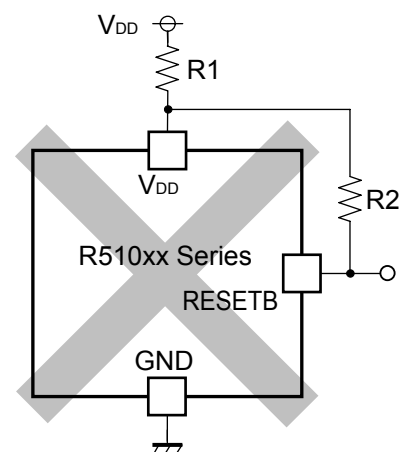


Figure C



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■ Ricoh awarded ISO 14001 certification.

The Ricoh Group was awarded ISO 14001 certification, which is an international standard for environmental management systems, at both its domestic and overseas production facilities. Our current aim is to obtain ISO 14001 certification for all of our business offices.

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Ricoh completed the organization of the Lead-free production for all of our products. After Apr. 1, 2006, we will ship out the lead free products only. Thus, all products that will be shipped from now on comply with RoHS Directive.