

## Microprocessor Supervisory Circuit with 2 Clock Input Pin

NO.EA-172-200602

### OUTLINE

The R5109G is a microprocessor supervisory circuit and has 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  $\pm 16\%$ <sup>(1)</sup>. When the supply voltage becomes 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  $\pm 33\%$ <sup>(1)</sup>.

The function to stop supervising clock by the watchdog timer (INH function) and the function to supervise two different clocks are built in this IC. There are another 4 products by the difference of packages and the function of voltage detector and watchdog timer. The package of R5109G is SSOP-8G.

### FEATURES

- Operating Voltage Range (Maximum Rating) ..... 0.9V to 6.0V (7.0V)
- Supply Current ..... Typ. 11.5 $\mu$ A

#### < 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 .....  $\pm 16\%$ <sup>(1)</sup> ( $-40^{\circ}\text{C} \leq T_a \leq 105^{\circ}\text{C}$ )
- Power-on reset delay time of the voltage detector ..... Typ. 370ms with an external capacitor : 0.1 $\mu$ F

#### < Watchdog Timer Part >

- Built-in a watchdog timer's time out period accuracy .....  $\pm 33\%$ <sup>(1)</sup> ( $-40^{\circ}\text{C} \leq T_a \leq 105^{\circ}\text{C}$ )
- Timeout period for watchdog timer ..... Typ. 310ms with an external capacitor : 0.1 $\mu$ F
- Reset timer for watchdog timer ..... Typ. 34ms with an external capacitor : 0.1 $\mu$ F
- With Inhibit pin (INH) ..... Able to stop watchdog timer
- Dual clock input ..... Able to supervise two microprocessors
- Package ..... SSOP-8G

### APPLICATIONS

- Supervisory circuit for equipment with using microprocessors.

<sup>(1)</sup> Accuracy to center value of (Min.+Max.)/2

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**R5109G**

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NO.EA-172-200602

**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
R5109Gxx1*-TR-FE	SSOP-8G	3,000 pcs	Yes	Yes

xx: The detector threshold ( $-V_{DET}$ ) can be designated in the range from 1.5V(15) to 5.5V(55) in 0.1V steps.

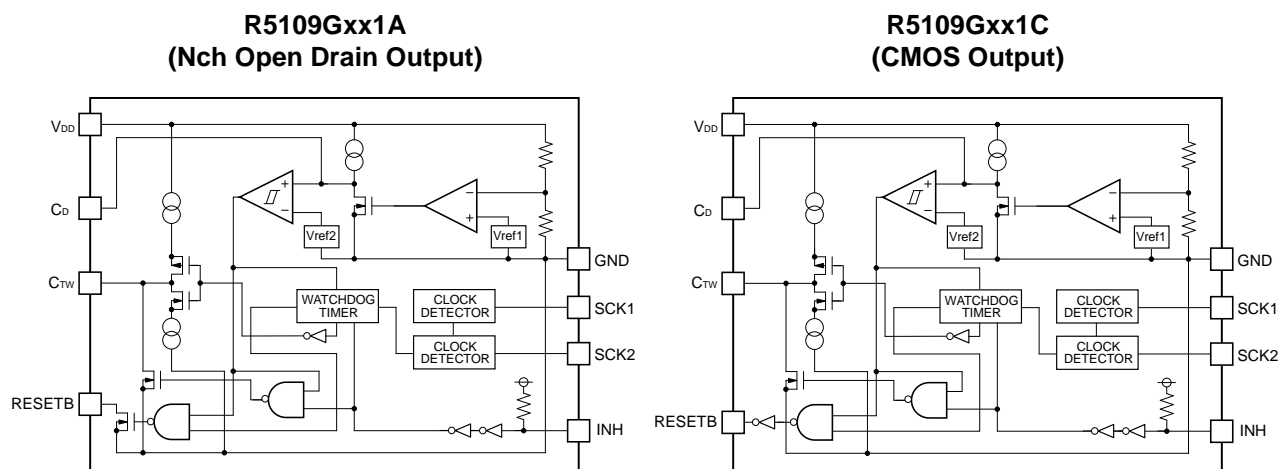
\* : Designation of Output Type  
(A) Nch Open Drain  
(C) CMOS

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**Series Selection**

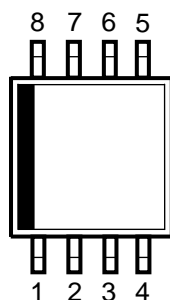
	R5105N	R5106N	R5107G	R5108G	R5109G
Package	SOT-23-6		SSOP-8G		
With INH pin (Inhibit)	No	Yes			
2 clock input	No				Yes
With MR pin (Manual Reset)	No		Yes	No	
With SENSE pin	No			Yes	No
Remarks		C <sub>D</sub> pin and C <sub>TW</sub> pin are combined uses.		Operating Voltage Range 1.5V to 6.0V	Supply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

## BLOCK DIAGRAMS



## PIN DESCRIPTIONS

### ● SSOP-8G



Pin No.	Symbol	Description
1	RESETB	Output Pin for Reset signal of Watchdog timer and Voltage Detector. (Output "L" at detecting Detector Threshold and Watchdog Timer Reset.)
2	INH	Inhibit Pin ("L": Inhibit the watchdog timer)
3	C <sub>D</sub>	External Capacitor Pin for Setting Delay Time of Voltage Detector
4	GND	Ground Pin
5	SCK1	Clock Input Pin 1 from Microprocessor
6	SCK2	Clock Input Pin 2 from Microprocessor
7	C <sub>TW</sub>	External Capacitor Pin for Setting Reset and Watchdog Timeout Periods
8	V <sub>DD</sub>	Power supply Pin

**ABSOLUTE MAXIMUM RATINGS**

(Ta=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 SCK1, SCK2 Pin	−0.3 to 7.0	V
V <sub>INH</sub>		Voltage of INH 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 <sup>(1)</sup> (SSOP-8G)		380	mW
T <sub>j</sub>	Junction Temperature		−40 to 125	°C
T <sub>stg</sub>	Storage Temperature Range		−55 to 125	°C

**ABSOLUTE MAXIMUM RATINGS**

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause permanent damage 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 are not assured.

**RECOMMENDED OPERATING CONDITONS**

Symbol	Item	Rating	Unit
V <sub>IN</sub>	Input Voltage	0.9 to 6.0	V
Ta	Operating Temperature Range	−40 to 105	°C

**RECOMMENDED OPERATING CONDITIONS**

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 they are used over such ratings by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

<sup>(1)</sup> Refer to *POWER DISSIPATION* for detailed information.

## 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  $100k\Omega$  (R5109Gxx1A), unless otherwise noted.

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

### R5109Gxx1A/C

(Ta=25°C)

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$I_{SS}$	Supply Current	$V_{DD} = -V_{DET} + 0.5V$ , Clock pulse input		11.5	<span style="border: 1px solid black; padding: 0 2px;">15.5</span>	$\mu A$

### VD Part

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold	$T_a = 25^{\circ}C$	$\times 0.990$		$\times 1.010$	V
		$-40^{\circ}C \leq T_a \leq 105^{\circ}C$	<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} \times 0.03</math></span>	$-V_{DET} \times 0.05$	<span style="border: 1px solid black; padding: 0 2px;"><math>-V_{DET} \times 0.07</math></span>	V
$\Delta -V_{DET} / \Delta T_a$	Detector Threshold Temperature Coefficient	$-40^{\circ}C \leq T_a \leq 105^{\circ}C$		$\pm 100$		ppm/ $^{\circ}C$
$t_{PLH}$	Output Delay Time	$C_D = 0.1\mu F$ <sup>(1)</sup>	<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 <sup>(2)</sup> $V_{DD}=6.0V$ $V_{DS}=0.5V$	<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	$C_{TW}=0.1\mu F$ <sup>(1)</sup>	<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	$C_{TW}=0.1\mu F$ <sup>(1)</sup>	<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"	SCK1, SCK2	<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"	SCK1, SCK2	<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
$V_{INH H}$	INH Input "H"		<span style="border: 1px solid black; padding: 0 2px;">1.0</span>		<span style="border: 1px solid black; padding: 0 2px;">6.0</span>	V
$V_{INH L}$	INH Input "L"		<span style="border: 1px solid black; padding: 0 2px;">0</span>		<span style="border: 1px solid black; padding: 0 2px;">0.35</span>	V
$R_{INH}$	INH pull-up Resistance		<span style="border: 1px solid black; padding: 0 2px;">60</span>	110	<span style="border: 1px solid black; padding: 0 2px;">164</span>	$k\Omega$
$t_{SCKW}$	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 test items listed under *Electrical Characteristics* are done under the pulse load condition ( $T_j \approx T_a = 25^{\circ}C$ ) except for Detector Threshold Temperature Coefficient.

<sup>(1)</sup> The specification does not contain the temperature characteristics of the external capacitor.

<sup>(2)</sup> In case of CMOS type (R5109Gxx1C)

## R5109G

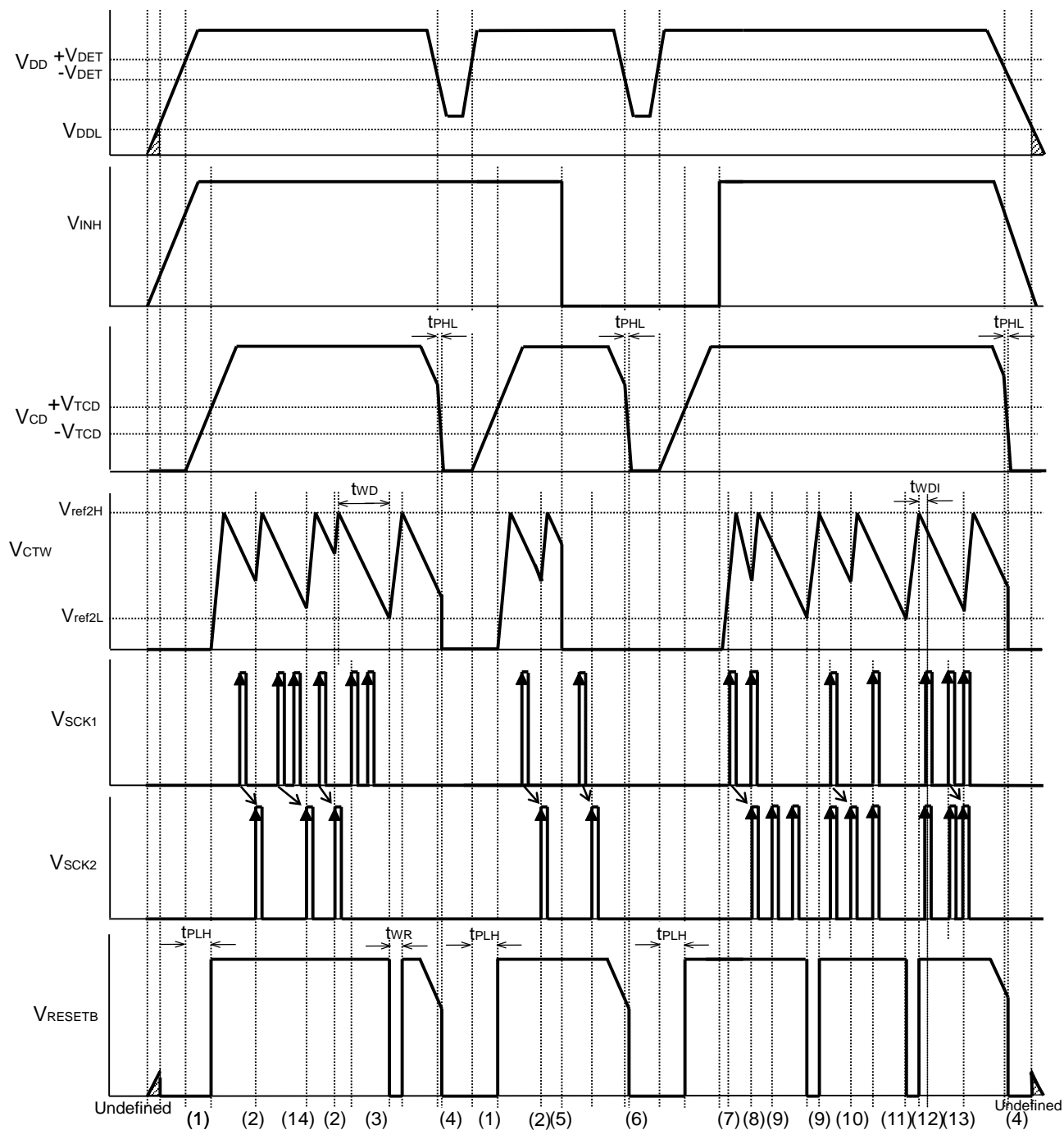
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### Product-specific Electrical Characteristics

Product Name	-V <sub>DET</sub>						V <sub>HYS</sub>		
	Ta = 25°C			-40°C ≤ Ta ≤ 105 °C					
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.
R5109G151x	1.485	1.500	1.515	1.4580	1.500	1.5225	0.045	0.075	0.105
R5109G161x	1.584	1.600	1.616	1.5552	1.600	1.6240	0.048	0.080	0.112
R5109G171x	1.683	1.700	1.717	1.6524	1.700	1.7255	0.051	0.085	0.119
R5109G181x	1.782	1.800	1.818	1.7496	1.800	1.8270	0.054	0.090	0.126
R5109G191x	1.881	1.900	1.919	1.8468	1.900	1.9285	0.057	0.095	0.133
R5109G201x	1.980	2.000	2.020	1.9440	2.000	2.0300	0.060	0.100	0.140
R5109G211x	2.079	2.100	2.121	2.0412	2.100	2.1315	0.063	0.105	0.147
R5109G221x	2.178	2.200	2.222	2.1384	2.200	2.2330	0.066	0.110	0.154
R5109G231x	2.277	2.300	2.323	2.2356	2.300	2.3345	0.069	0.115	0.161
R5109G241x	2.376	2.400	2.424	2.3328	2.400	2.4360	0.072	0.120	0.168
R5109G251x	2.475	2.500	2.525	2.4300	2.500	2.5375	0.075	0.125	0.175
R5109G261x	2.574	2.600	2.626	2.5272	2.600	2.6390	0.078	0.130	0.182
R5109G271x	2.673	2.700	2.727	2.6244	2.700	2.7405	0.081	0.135	0.189
R5109G281x	2.772	2.800	2.828	2.7216	2.800	2.8420	0.084	0.140	0.196
R5109G291x	2.871	2.900	2.929	2.8188	2.900	2.9435	0.087	0.145	0.203
R5109G301x	2.970	3.000	3.030	2.9160	3.000	3.0450	0.090	0.150	0.210
R5109G311x	3.069	3.100	3.131	3.0132	3.100	3.1465	0.093	0.155	0.217
R5109G321x	3.168	3.200	3.232	3.1104	3.200	3.2480	0.096	0.160	0.224
R5109G331x	3.267	3.300	3.333	3.2076	3.300	3.3495	0.099	0.165	0.231
R5109G341x	3.366	3.400	3.434	3.3048	3.400	3.4510	0.102	0.170	0.238
R5109G351x	3.465	3.500	3.535	3.4020	3.500	3.5525	0.105	0.175	0.245
R5109G361x	3.564	3.600	3.636	3.4992	3.600	3.6540	0.108	0.180	0.252
R5109G371x	3.663	3.700	3.737	3.5964	3.700	3.7555	0.111	0.185	0.259
R5109G381x	3.762	3.800	3.838	3.6936	3.800	3.8570	0.114	0.190	0.266
R5109G391x	3.861	3.900	3.939	3.7908	3.900	3.9585	0.117	0.195	0.273
R5109G401x	3.960	4.000	4.040	3.8880	4.000	4.0600	0.120	0.200	0.280
R5109G411x	4.059	4.100	4.141	3.9852	4.100	4.1615	0.123	0.205	0.287
R5109G421x	4.158	4.200	4.242	4.0824	4.200	4.2630	0.126	0.210	0.294
R5109G431x	4.257	4.300	4.343	4.1796	4.300	4.3645	0.129	0.215	0.301
R5109G441x	4.356	4.400	4.444	4.2768	4.400	4.4660	0.132	0.220	0.308
R5109G451x	4.455	4.500	4.545	4.3740	4.500	4.5675	0.135	0.225	0.315
R5109G461x	4.554	4.600	4.646	4.4712	4.600	4.6690	0.138	0.230	0.322
R5109G471x	4.653	4.700	4.747	4.5684	4.700	4.7705	0.141	0.235	0.329
R5109G481x	4.752	4.800	4.848	4.6656	4.800	4.8720	0.144	0.240	0.336
R5109G491x	4.851	4.900	4.949	4.7628	4.900	4.9735	0.147	0.245	0.343
R5109G501x	4.950	5.000	5.050	4.8600	5.000	5.0750	0.150	0.250	0.350
R5109G511x	5.049	5.100	5.151	4.9572	5.100	5.1765	0.153	0.255	0.357
R5109G521x	5.148	5.200	5.252	5.0544	5.200	5.2780	0.156	0.260	0.364
R5109G531x	5.247	5.300	5.353	5.1516	5.300	5.3795	0.159	0.265	0.371
R5109G541x	5.346	5.400	5.454	5.2488	5.400	5.4810	0.162	0.270	0.378
R5109G551x	5.445	5.500	5.555	5.3460	5.500	5.5825	0.165	0.275	0.385

## THEORY OF OPERATION

## 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

\*)  $V_{DDL}$  : 0.9 V (Max.)

**Operating Description**

- (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) After the SCK1 pulse is input, when the SCK2 pulse is input, the watchdog timer 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  $V_{ref2H}$ , the mode will change into the discharge mode, and next watchdog time count starts.
- (3) After the SCK1 pulse is input, unless the SCK2 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" after the  $t_{PHL}$ .
- (5) If "L" signal is input to the INH pin, the RESETB outputs "H", regardless the SCK clock state.
- (6) During the "L" period of INH pin, the voltage detector monitors the supply voltage.
- (7) When the signal to the INH pin is set from "L" to "H", the watchdog starts supervising the system clock, or charge cycle to the  $C_{TW}$  pin starts, the capacitor connected to the  $C_{TW}$  pin is charged with the current of setting Reset time of WDT.
- (8) After the SCK1 pulse is input, when the SCK2 is input, the WDT will be cleared.
- (9) Without the input of SCK1 pulse input, even if the SCK2 pulse is input, the WDT will not be cleared.
- (10) After the SCK1 pulse is input, when the SCK2 is input, the WDT will be cleared.
- (11) If SCK1 pulse and SCK2 pulse are input at the same time, the WDT will not be cleared.
- (12) 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.
- (13) After the SCK1 pulse is input, when the SCK2 is input, the WDT will be cleared.
- (14) The WDT supervises SCK1 pulse and SCK2 pulse by turns, therefore, for example, if only SCK1 pulse is input twice or more without SCK2 pulse, the second or later consecutive SCK1 pulse will be ignored. After the SCK1 pulse is input, and when the SCK2 pulse is input, the WDT will be cleared. In the same way, if only SCK2 pulse is input twice or more without SCK1 pulse, the second or later consecutive SCK2 pulse will be ignored.

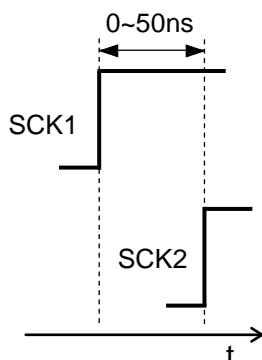
Too close timing of SCK1 pulse input and SCK2 pulse input means the rising edge interval time range from 0ns to 50ns. (Guaranteed by design, not mass production tested.)

Even if the SCK1 and SCK2 are input at almost the same time as above, the WDT will still try to supervise these two clock by turns.

Therefore, after the SCK1 pulse is input, if SCK1 pulse and SCK2 pulse are input at almost the same time, the WDT will be cleared. (as the status (8))

Likewise, after the SCK1 pulse and SCK2 pulse are input at almost the same time, when the SCK2 pulse is input, the WDT will be cleared. (as the status (10))

If the almost same timing input of SCK1 and SCK2 continues twice, the WDT will be cleared. (as the status (13))



### Example timing of too close input pulses

(This pattern will be recognized the clock timing is same by the WDT)

### 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.

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

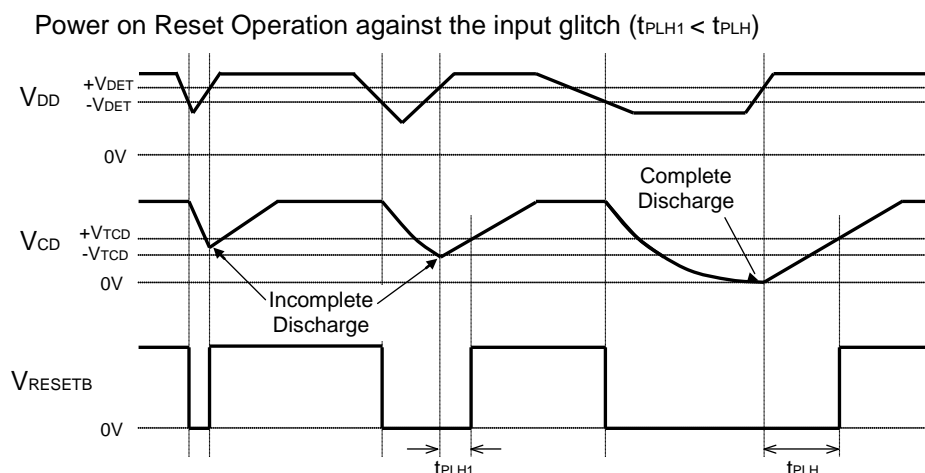
### Released Delay Time (Power-on Reset delay time)

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>).

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

The capacitor connected to C<sub>D</sub> pin determines t<sub>WD</sub>, t<sub>WR</sub>, and t<sub>PLH</sub>.

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.



### 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.)

### Inhibit (INH) Function

If INH pin is set at "L", the watchdog timer stops monitoring the clock, and the RESETB output will be dominant by the voltage detector's operation. Therefore, if the supply voltage is set at more than the detector threshold level, RESETB outputs "H" regardless the clock pulse. INH pin is pulled up with a resistor (Typ.110k $\Omega$ ) internally.

### 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.

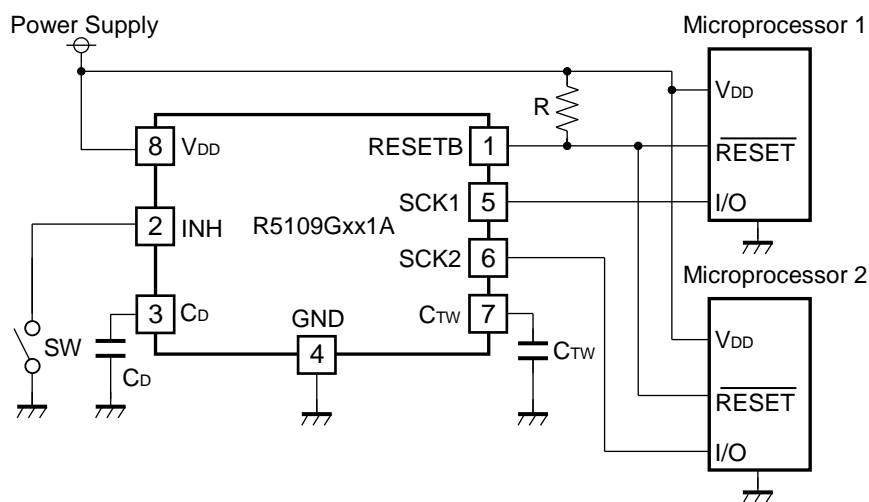
### Clock Pulse Input

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

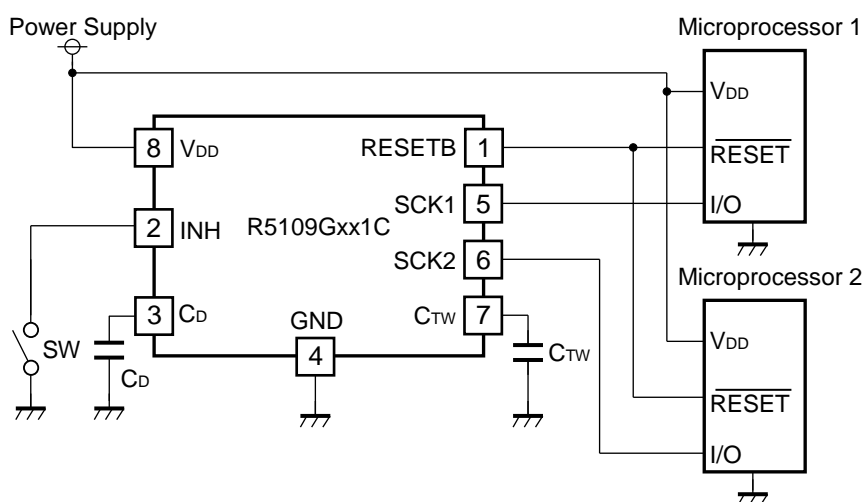
After the SCK1 clock pulse is input, when the SCK2 pulse is input, the watchdog timer will be cleared. If the system requires only one clock supervise, SCK1 pin and SCK2 pin must connect each other. In this case, the watchdog timer is cleared with every other clock pulse. Depending on the timing of these two clock pulses, SCK1 pulse and SCK2 pulse are recognized at almost the same time by the watchdog timer, during the watchdog timeout period, after the SCK1 clock pulse, two or more SCK2 clock pulses are desirable to put into.

## APPLICATION INFORMATION

### Typical Application Circuits



R5109Gxx1A



R5109Gxx1C

## 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<sup>(1)</sup>, 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 100k $\Omega$  or less as a guide, and connect C<sub>IN</sub><sup>(2)</sup> of 0.1 $\mu$ F 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.

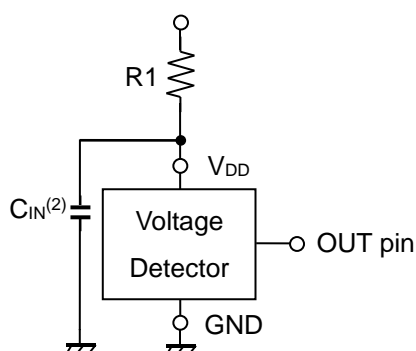


Figure A

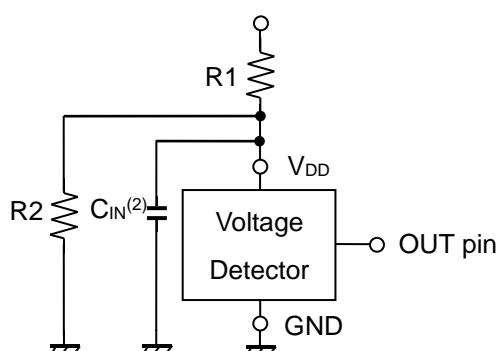


Figure B

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<sup>(1)</sup> In the CMOS output type, a charging current for OUT pin is included.

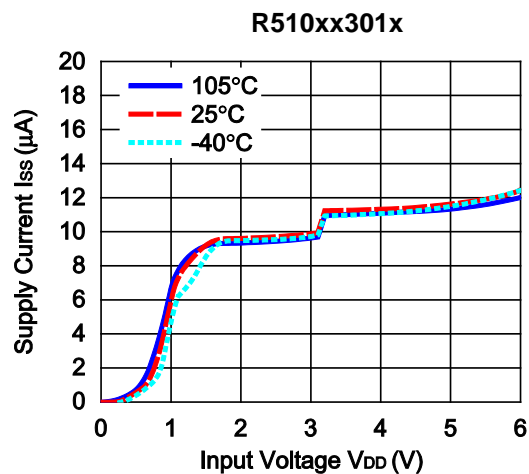
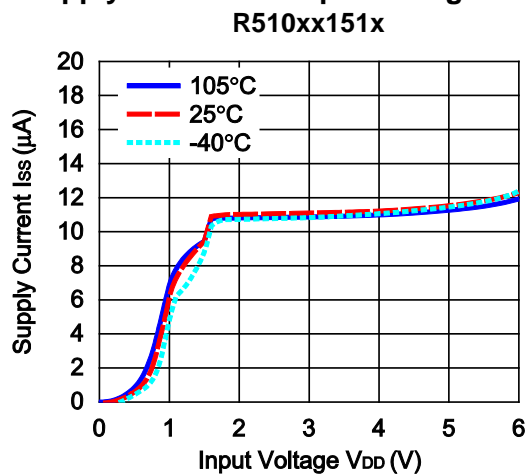
<sup>(2)</sup> Note the bias dependence of capacitors.

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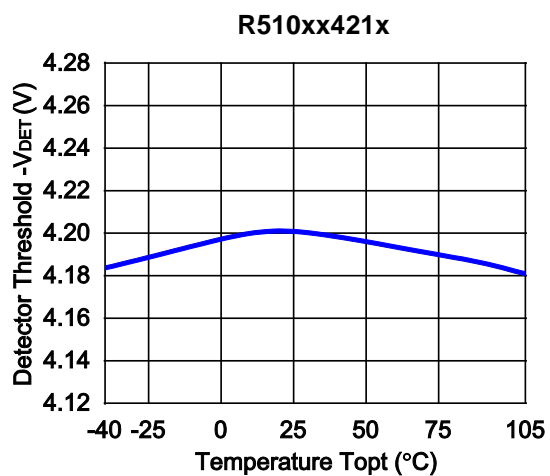
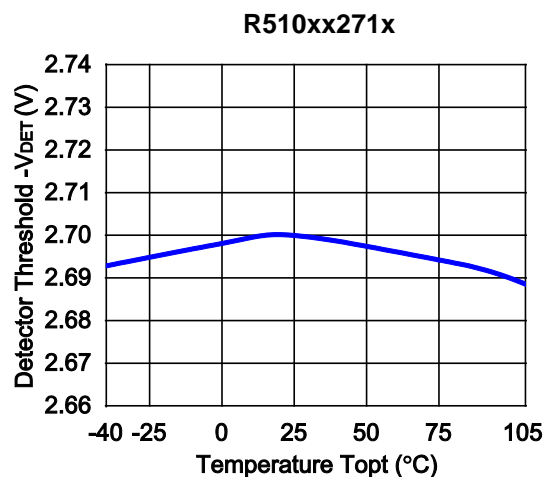
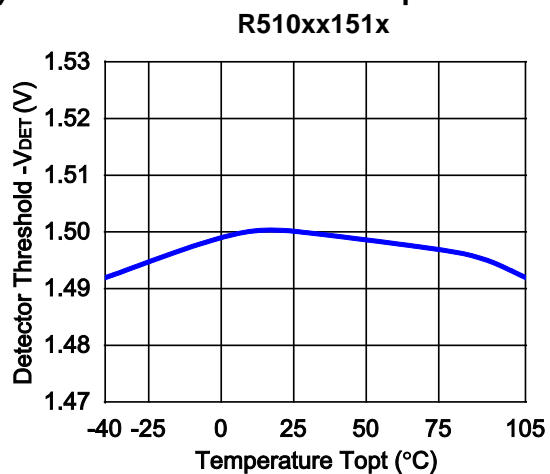
## TYPICAL CHARACTERISTICS

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

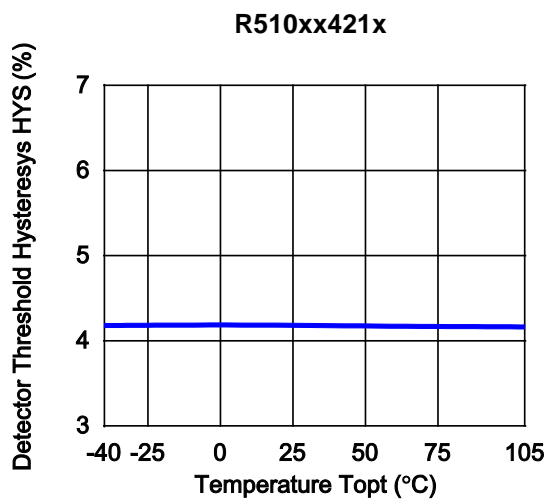
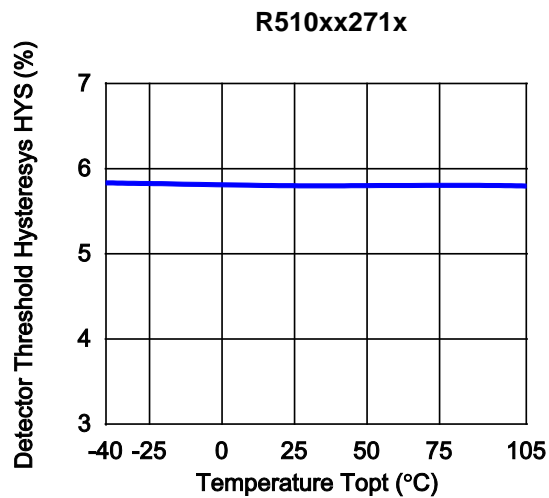
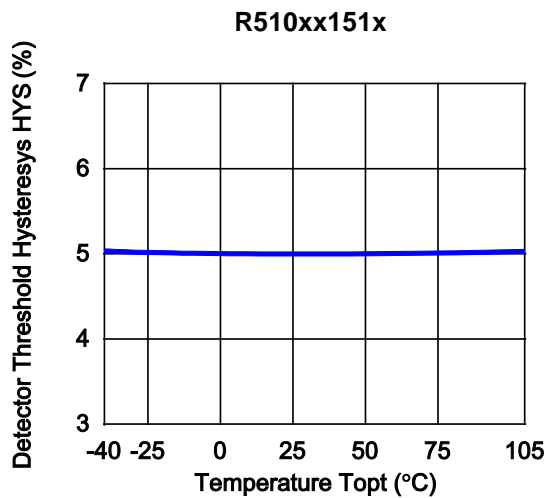
### 1) Supply Current vs. Input Voltage



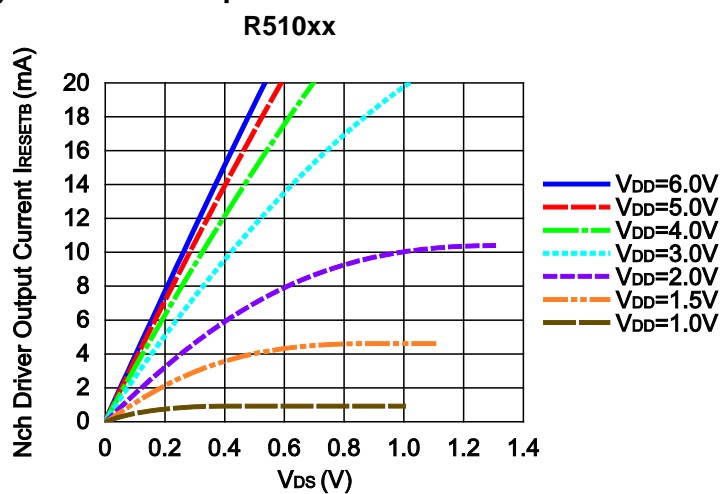
### 2) Detector Threshold vs. Temperature



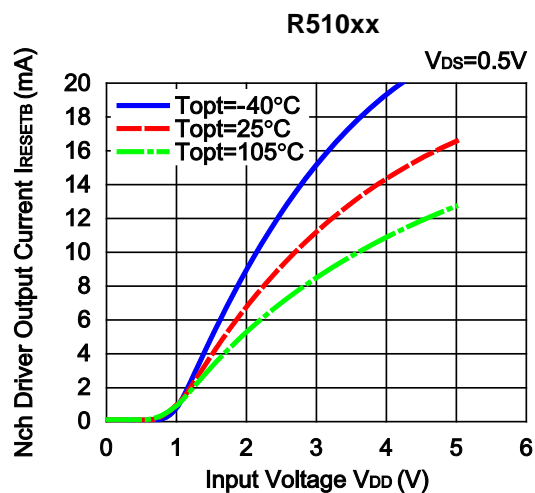
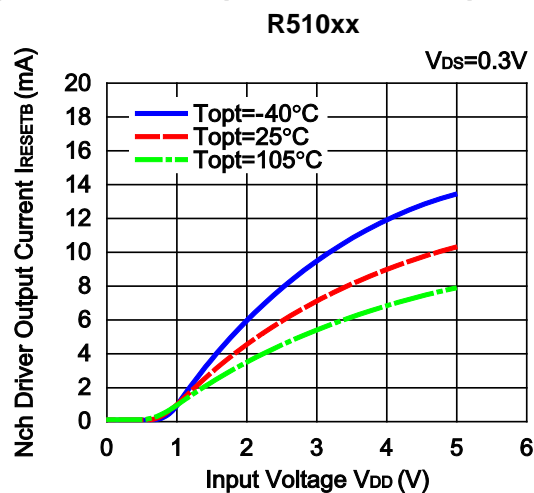
### 3) Detector Threshold Hysteresis vs. Temperature



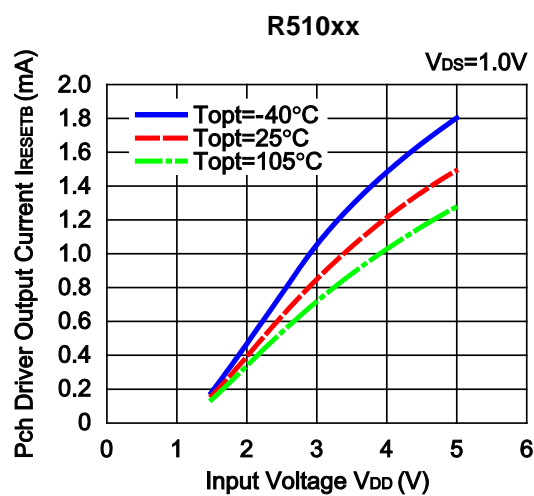
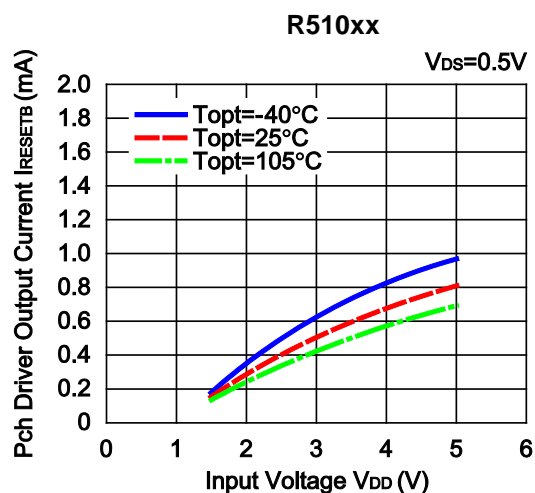
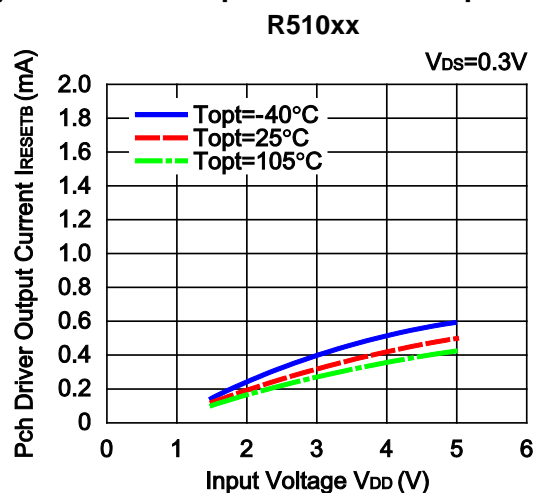
### 4) Nch Driver Output Current vs. Vds



## 5) Nch Driver Output Current vs. Input Voltage

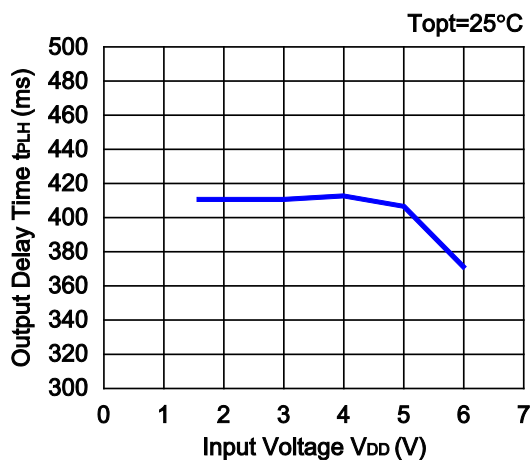


## 6) Pch Driver Output Current vs. Input Voltage



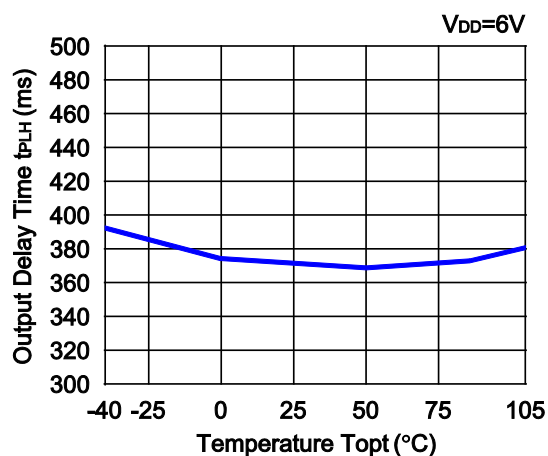
**7) Released Delay Time vs. Input Voltage**

R510xx



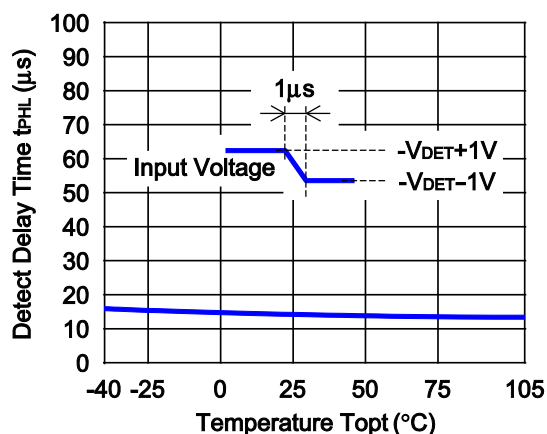
**8) Released Delay Time vs. Temperature**

R510xx



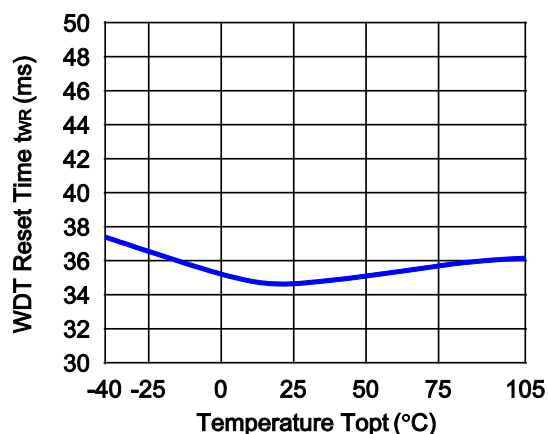
**9) Detector Output Delay Time vs. Temperature**

R510xx



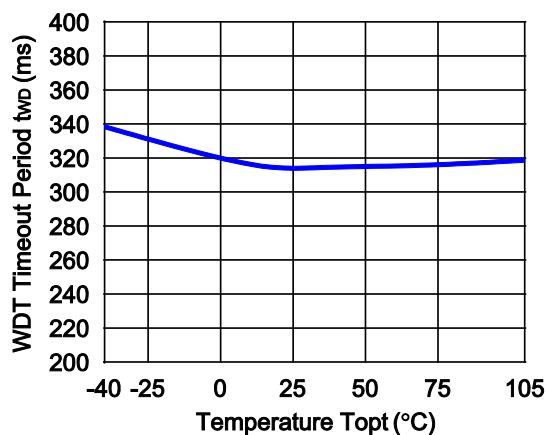
**10) WDT Reset Timer vs. Temperature**

R510xx



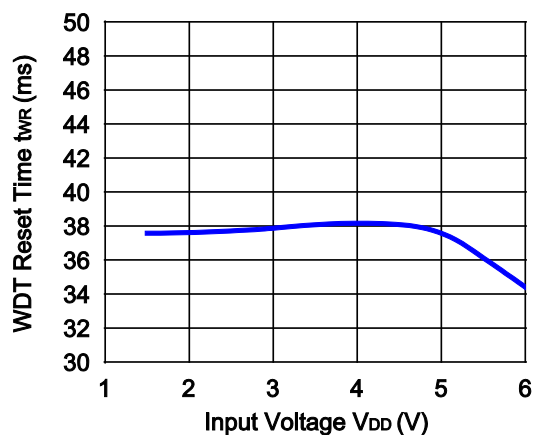
**11) WDT Timeout Period vs. Temperature**

R510xx



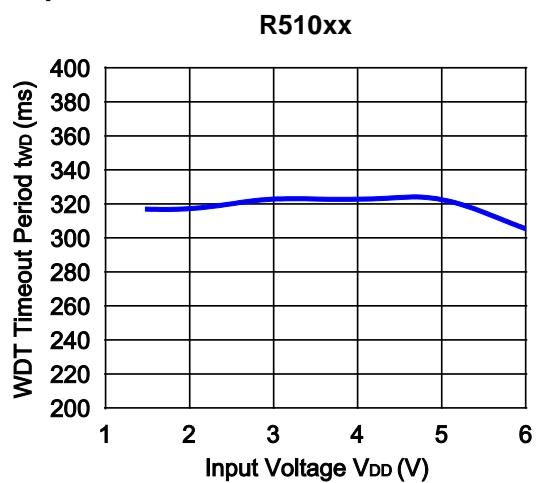
**12) WDT Reset Timer vs. Input Voltage**

R510xx



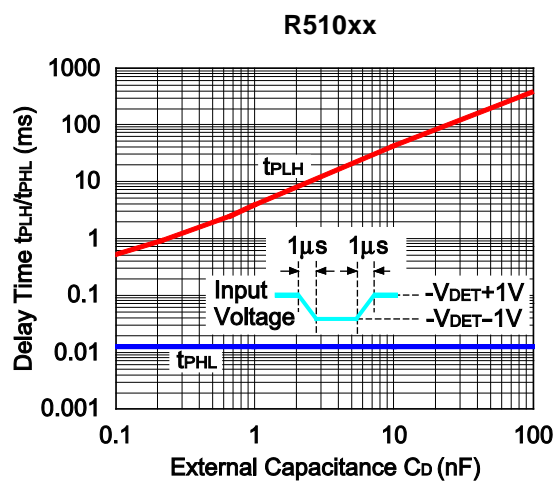
## 13) WDT Timeout Period vs. Input Voltage

Capacitance



## 14) Output Delay Time vs. External

Capacitance



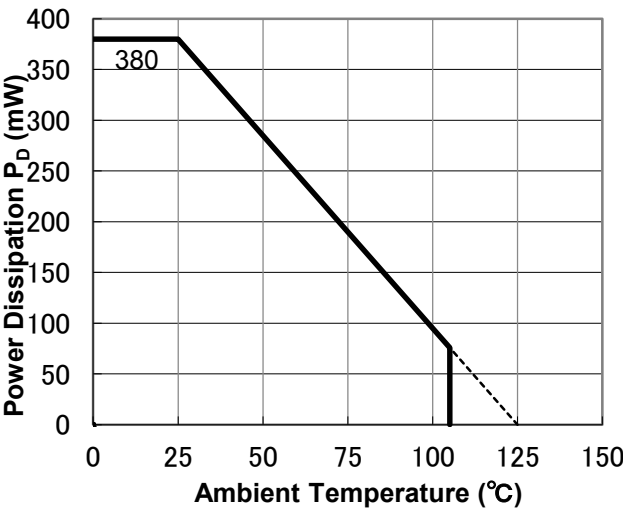
The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following conditions are used in this measurement.

Measurement Conditions

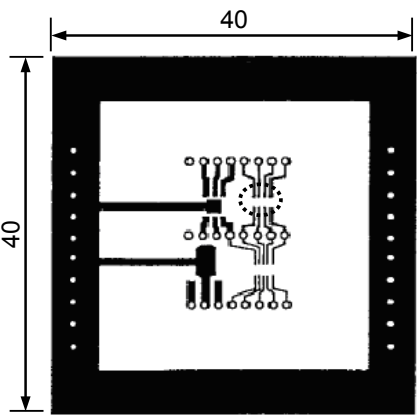
	Standard Test Land Pattern
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Double-Sided Board)
Board Dimensions	40 mm × 40 mm × 1.6 mm
Copper Ratio	Top Side: Approx. 50% Bottom Side: Approx. 50%
Through-holes	φ 0.5 mm × 44 pcs

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

	Standard Test Land Pattern
Power Dissipation	380 mW
Thermal Resistance	$\theta_{ja} = (125 - 25^{\circ}\text{C}) / 0.38 \text{ W} = 263^{\circ}\text{C/W}$
	$\theta_{jc} = 60^{\circ}\text{C/W}$

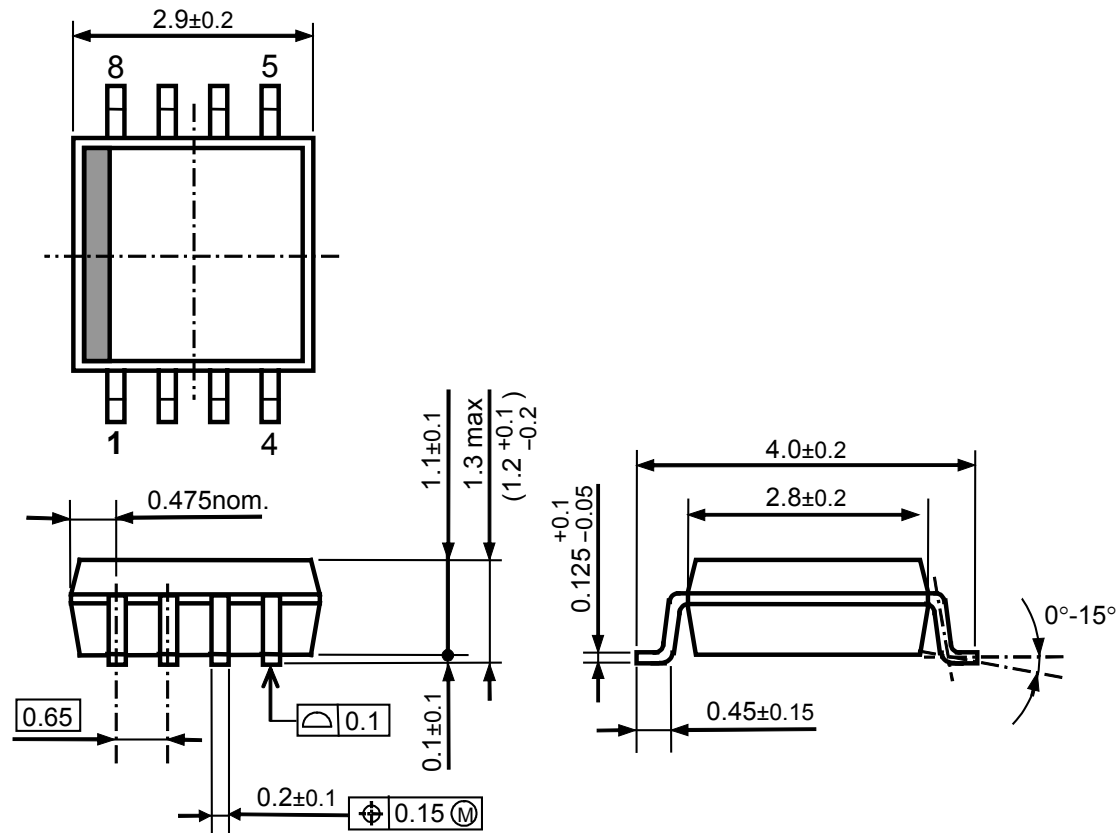


Power Dissipation vs. Ambient Temperature



○ IC Mount Area (mm)

Measurement Board Pattern



SSOP-8G Package Dimensions (Unit: mm)



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