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Microprocessor power management with Watchdog Timer
R5101G Series

■ OUTLINE

The R5101G Series are microprocessor power management ICs with high accuracy output voltage and detector threshold and with ultra low supply current by CMOS process. Each of these ICs consists of a voltage regulator, a voltage detector and a watchdog timer. Thus, the R5101G Series have the function of a power management for microprocessor, a monitor of the voltage of a power source and a microprocessor supervisor.

The built-in voltage regulator with an internal driver transistor can supply typically 50mA current to a system when the voltage difference between input and output is 2V. Therefore these ICs are very suitable for various power supply systems for microprocessors. The output voltage is monitored by the voltage detector which is built-in these ICs.

The built-in voltage detector has an output delay function and the delay time can be set by an external capacitor(C_D).

The output voltage and the detector threshold voltage can be set individually for each IC by laser trimming.

Furthermore, when a microprocessor works incorrectly, the watchdog timer which checks over microprocessor generates reset signals intermittently to prevent a whole system from being malfunction.

The time period for watching and holding a reset signal of the watchdog timer can also be set individually by an external capacitor(C_{TW}).

■ FEATURES

- ● Built-in a watchdog timer
- ● Time period for monitoring and generating a reset signal of the watchdog timer can be set by an external capacitor
- ● Watchdog timer can be stopped individually by CE Pin
- ● Low supply current •TYP. 5μA
- ● The output voltage of Voltage Regulator and the detector threshold voltage can be set individually with a step of 0.1V for each IC by laser trim
- ● High Accuracy Output Voltage of Voltage Regulator and Detector Threshold • • • • ±2.5%
- ● Power-on Reset Delay Time can be set by an external capacitor
- ● Output Current • • • • • • • Typ. 50mA (at Vin - Vout = 2V)
- ● Small Package • • • Ultra-mini SSOP-8G (0.65mm pitch) Refer to Package Dimensions

■ APPLICATION

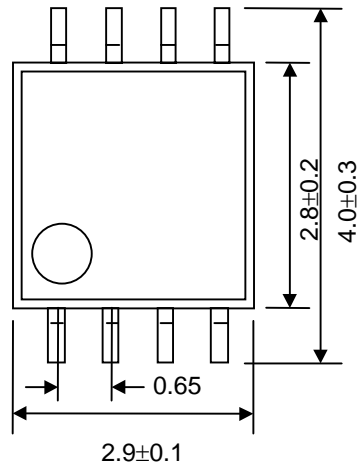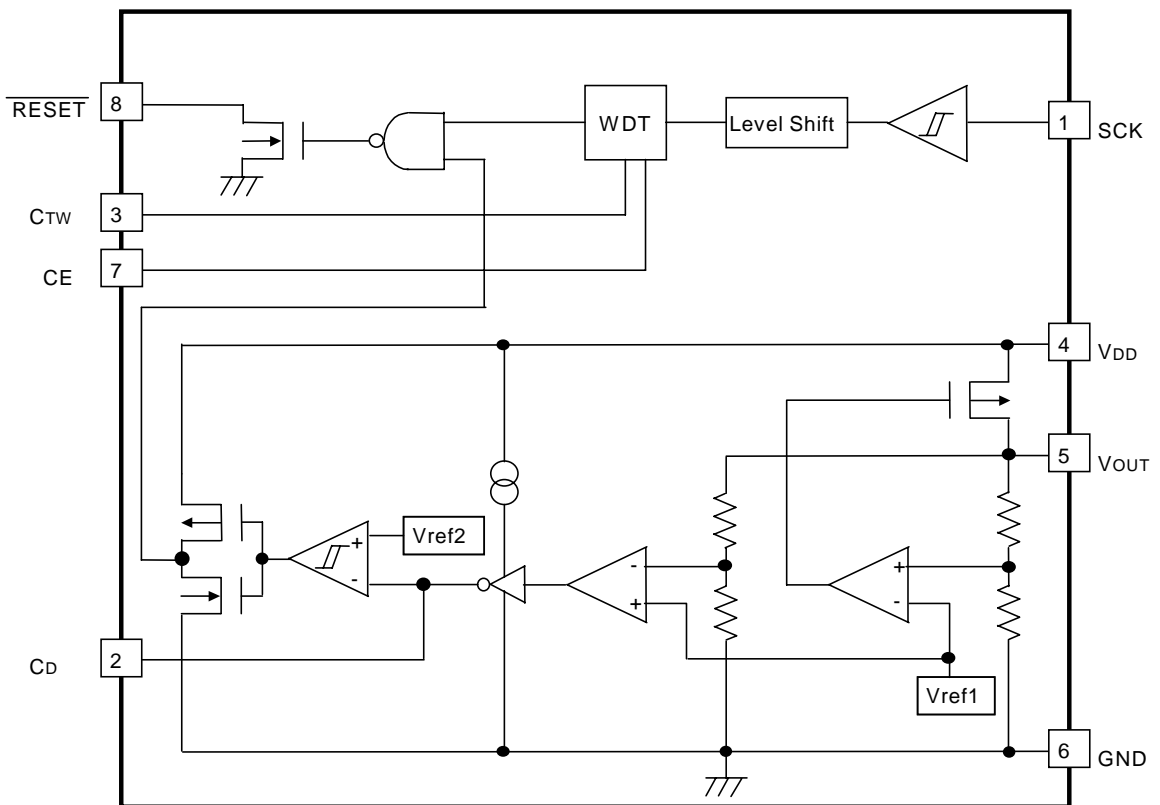- ● Power source for microprocessors

■ PIN CONFIGURATION

SSOP8G(0.65mm pitch)

SCK		Reset
C_D		CE
C_{TW}		GND
V_{DD}		V_{OUT}

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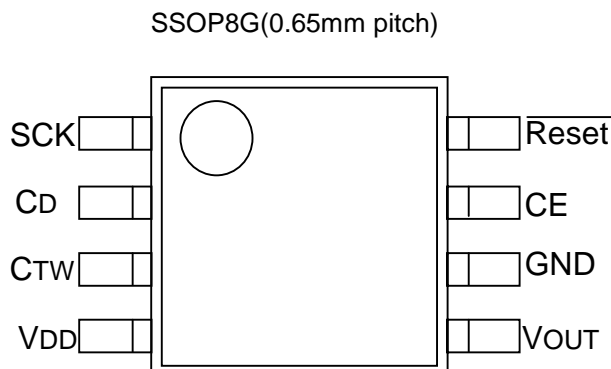
■ PACKAGE DIMENSIONS

SSOP8G

2.8±0.2

4.0±0.3

0.65

2.9±0.1

Unit : mm

■ BLOCK DIAGRAMS

■ PIN DESCRIPTION

Pin No.	Symbol	Description
1	SCK	Clock Input Pin from Microprocessor
2	CD	External Capacitor Pin for Setting Delay Time of Voltage Detector
3	CTW	External Capacitor Pin for Setting Monitoring Time and Reset Time of Watchdog timer
4	V_{DD}	Power supply Pin
5	V_{OUT}	Output Pin for Voltage Regulator
6	GND	Ground Pin
7	CE	Control Switch Pin for Watchdog timer ("H" active, "L" inactive)
8	$\overline{RESET}$	Output Pin for Reset signal of Watchdog timer and Voltage Detector.(Output Type is Nch Open Drain, Output "L" at detecting Detector Threshold and Watchdog Timer Reset.)

■ ABSOLUTE MAXIMUM RATINGS

Topt=25°C, Vss=0V

Symbol	Item		Rating	Unit
V_{DD}	Supply Voltage		-0.3~12	V
V_{CD}	Output Voltage	Voltage of CD Pin	V_{ss}-0.3~V_{DD}+0.3	V
V_{CTW}		Voltage of CTW Pin	V_{ss}-0.3~V_{DD}+0.3	V
V_{OUT}		Voltage of V_{OUT} Pin	V_{ss}-0.3~V_{DD}+0.3	V
V_{RESET}		Voltage of RESET Pin	V_{ss}-0.3~12	V
V_{CE}	Input Voltage	Voltage of CE Pin	V_{ss}-0.3~V_{DD}+0.3	V
V_{SCK}		Voltage of SCK Pin	V_{ss}-0.3~V_{DD}+0.3	V
I_{OUT}	Output Current	Current of V_{OUT} Pin	150	mA
I_{RESET}		Current of RESET Pin	10	mA
P_D	Power Dissipation		300	mW
T_{opt}	Operating Temperature Range		-40~+85	°C
T_{stg}	Storage Temperature Range		-55~+125	°C

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■ ELECTRICAL CHARACTERISTICS

●R5101G001A   Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{DD}	Operating Voltage				10	V
Iss-On	Supply Current (WDT active)	V_{DD}=CE=5.0V		5	15	μA
Iss-Off	Supply Current (WDT inactive)	V_{DD}=5.0V, CE=GND		6	18	μA
V_{OUT}	Output Voltage	V_{DD}=5.0V,I_{OUT}=10mA	2.925	3.000	3.075	V
I_{OUT}	Output Current	V_{DD}=5.0V	100			mA
V_{DIF}	Dropout Voltage	I_{OUT}=30mA	150	500	850	mV
ΔV_{OUT}/ ΔI_{OUT}	Load Regulation	V_{DD}=5.0V 1mA≤I_{OUT}≤50mA		50	100	mV
ΔV_{OUT}/ ΔV_{DD}	Line Regulation	I_{OUT}=10mA V_{OUT}+0.5V≤V_{DD}≤10V		0.1	0.2	%/V
Ilim	Current Limit (Short mode)	V_{OUT}=0V	10	50	100	mA
ΔV_{OUT}/ ΔTopt	Output Voltage Temperature Coefficient	I_{OUT}=10mA -40°C≤Topt≤85°C		±100		ppm/ °C
-V_{DET}	Detector Threshold		2.633	2.700	2.767	V
V_{HYS}	Hysteresis Range		0.081	0.135	0.189	V
V_{DETMGN}	Regulator Voltage Margin against Released Voltage	V_{OUT}-((-V_{DET})+V_{HYS}), I_{OUT}=10mA	0.02			V
Δ-V_{DET}/ ΔTopt	Detector Threshold Temperature Coefficient	-40°C≤Topt≤85°C		±100		ppm/ °C
tpr	Reset Delay Time	V_{DD}=5.0V, CD=0.001μF	7	14	21	ms
twd	Watch Time of WDT	V_{DD}=5.0V, CW=0.01μF	50	100	150	ms
twr	Reset Hold Time of WDT	V_{DD}=5.0V, CW=0.01μF	5	10	15	ms
V_{IHSCK}	SCK Input Voltage " H "	V_{DD}=5.0V	0.8×V_{OUT}		V_{DD}	V
V_{ILSCK}	SCK Input Voltage " L "	V_{DD}=5.0V	0		0.2×V_{OUT}	V
V_{IHCE}	CE Input Voltage " H "		1.2		V_{DD}	V
V_{ILCE}	CE Input Voltage " L "		0		0.2	V
I_{IHSCK}	SCK Input Current " H "	V_{DD}=SCK=5.0V	-1		1	μA
I_{ILSCK}	SCK Input Current " L "	V_{DD}=5.0V, SCK=GND	-1		1	μA
Rpu	CE Pull-up Resistance		2	4	10	MΩ
I_{CD}	CD Pin Output Current	V_{DD}=1.3V,V_{DS}=0.5V	1	2		mA
I_{CTW}	CTW Pin Output Current	V_{DD}=1.3V,V_{DS}=0.5V	1	2		mA
$\overline{I_{RESET}}$	$\overline{RESET}$ Pin Output Current	V_{DD}=1.3V,V_{DS}=0.5V	1	2		mA
Ileak	$\overline{RESET}$ Pin Leakage Current	VDD=10.0V,CE=GND,VDS=12.0V	-1		1	μA
tsckw	SCK Input Pulse Width	V_{DD}=5.0V, CW=0.01μF	500			ns
Vstart	Minimum Operating Voltage of Voltage Detector			0.9	1.3	V

●R5101G002A   Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{DD}	Operating Voltage				10	V
Iss-On	Supply Current (WDT active)	V_{DD}=CE5.3V		5	15	μA
Iss-Off	Supply Current (WDT inactive)	V_{DD}=5.3V, CE=GND		6	18	μA
V_{OUT}	Output Voltage	V_{DD}=5.3V, I_{OUT}=10mA	3.218	3.300	3.382	V
I_{OUT}	Output Current	V_{DD}=5.3V	50			mA
V_{DIF}	Dropout Voltage	I_{OUT}=30mA	100	500	650	mV
$\Delta V_{OUT}/$ ΔI_{OUT}	Load Regulation	V_{DD}=5.3V 1mA≤I_{OUT}≤50mA		50	100	mV
$\Delta V_{OUT}/$ ΔV_{DD}	Line Regulation	I_{OUT}=10mA V_{OUT}+0.5V≤V_{DD}≤10V		0.1	0.2	%/V
Ilim	Current Limit (Short mode)	V_{OUT}=0V	10	50	100	mA
$\Delta V_{OUT}/$ ΔTopt	Output Voltage Temperature Coefficient	I_{OUT}=10mA -40°C≤Topt≤85°C		±100		ppm/ °C
-V_{DET}	Detector Threshold		2.925	3.000	3.075	V
V_{HYS}	Hysteresis Range		0.090	0.150	0.210	V
V_{DETMGN}	Regulator Voltage Margin against Released Voltage	V_{OUT}-((-V_{DET})+V_{HYS}), I_{OUT}=10mA	0.02			V
Δ-$V_{DET}/$ ΔTopt	Detector Threshold Temperature Coefficient	-40°C≤Topt≤85°C		±100		ppm/ °C
tpr	Reset Delay Time	V_{DD}=5.3V, CD=0.001μF	7	14	21	ms
twd	Watch Time of WDT	V_{DD}=5.3V, CW=0.01μF	50	100	150	ms
twr	Reset Hold Time of WDT	V_{DD}=5.3V, CW=0.01μF	5	10	15	ms
V_{IHSCK}	SCK Input Voltage " H "	V_{DD}=5.3V	0.8×V_{OUT}		V_{DD}	V
V_{ILSCK}	SCK Input Voltage " L "	V_{DD}=5.3V	0		0.2×V_{OUT}	V
V_{IHCE}	CE Input Voltage " H "		1.2		V_{DD}	V
V_{ILCE}	CE Input Voltage " L "		0		0.2	V
I_{IHSCK}	SCK Input Current " H "	V_{DD}=SCK=5.3V	-1		1	μA
I_{ILSCK}	SCK Input Current " L "	V_{DD}=5.3V, SCK=GND	-1		1	μA
Rpu	CE Pull-up Resistance			4		MΩ
I_{CD}	CD Pin Output Current	V_{DD}=1.3V,V_{DS}=0.5V	1	2		mA
I_{CTW}	CTW Pin Output Current	V_{DD}=1.3V,V_{DS}=0.5V	1	2		mA
$I_{\overline{RESET}}$	$\overline{RESET}$ Pin Output Current	V_{DD}=1.3V,V_{DS}=0.5V	1	2		mA
Ileak	$\overline{RESET}$ Pin Leakage Current	VDD=10.0V,CE=GND,VDS=12.0V	-1		1	μA
tsckw	SCK Input Pulse Width	V_{DD}=5.3V, SCK=GND	500			ns
Vstart	Minimum Operating Voltage of Voltage Detector			0.9	1.3	V

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●R5101G003A   Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V$_{DD}$	Operating Voltage				10	V
Iss-On	Supply Current (WDT active)	V$_{DD}$=CE=7.0V		7	20	μA
Iss-Off	Supply Current (WDT inactive)	V$_{DD}$=7.0V, CE=GND		8	24	μA
V$_{OUT}$	Output Voltage	V$_{DD}$=7.0V, I$_{OUT}$=10mA	4.875	5.000	5.125	V
I$_{OUT}$	Output Current	V$_{DD}$=7.0V	50			mA
V$_{DIF}$	Dropout Voltage	I$_{OUT}$=30mA	100	350	600	mV
ΔV$_{OUT}$/ ΔI$_{OUT}$	Load Regulation	V$_{DD}$=7.0V 1mA≤I$_{OUT}$≤50mA		50	100	mV
ΔV$_{OUT}$/ ΔV$_{DD}$	Line Regulation	I$_{OUT}$=10mA V$_{OUT}$+0.5V≤VDD≤10V		0.1	0.2	%/V
Ilim	Current Limit (Short mode)	V$_{OUT}$=0V	10	50	100	mA
ΔV$_{OUT}$/ ΔTopt	Output Voltage Temperature Coefficient	I$_{OUT}$=10mA -40°C≤Topt≤85°C		±100		ppm/ °C
-V$_{DET}$	Detector Threshold		4.388	4.500	4.590	V
V$_{HYS}$	Hysteresis Range		0.135	0.225	0.315	V
V$_{DETMGN}$	Regulator Voltage Margin against Released Voltage	V$_{OUT}$-((-V$_{DET}$)+V$_{HYS}$), I$_{OUT}$=10mA	0.02			V
Δ-V$_{DET}$/ ΔTopt	Detector Threshold Temperature Coefficient	-40°C≤Topt≤85°C		±100		ppm/ °C
tpr	Reset Delay Time	V$_{DD}$=7.0V, CD=0.001μF	7	14	21	ms
twd	Watch Time of WDT	V$_{DD}$=7.0V, CW=0.01μF	50	100	150	ms
twr	Reset Hold Time of WDT	V$_{DD}$=7.0V, CW=0.01μF	5	10	15	ms
V$_{IHSCK}$	SCK Input Voltage " H "	V$_{DD}$=7.0V	0.8×V$_{OUT}$		V$_{DD}$	V
V$_{ILSCK}$	SCK Input Voltage " L "	V$_{DD}$=7.0V	0		0.2×V$_{OUT}$	V
V$_{IHCE}$	CE Input Voltage " H "		1.2		V$_{DD}$	V
V$_{ILCE}$	CE Input Voltage " L "		0		0.2	V
I$_{IHSCK}$	SCK Input Current " H "	V$_{DD}$=SCK=7.0V	-1		1	μA
I$_{ILSCK}$	SCK Input Current " L "	V$_{DD}$=7.0V, SCK=GND	-1		1	μA
Rpu	CE Pull-up Resistance		2	4	10	MΩ
I$_{CD}$	CD Pin Output Current	V$_{DD}$=1.3V, V$_{DS}$=0.5V	1	2		mA
I$_{CTW}$	CTW Pin Output Current	V$_{DD}$=1.3V, V$_{DS}$=0.5V	1	2		mA
I$_{\overline{RESET}}$	$\overline{RESET}$ Pin Output Current	V$_{DD}$=1.3V, V$_{DS}$=0.5V	1	2		mA
Ileak	$\overline{RESET}$ Pin Leakage Current	VDD=10.0V, CE=GND, VDS=12.0V	-1		1	μA
tsckw	SCK Input Pulse Width	V$_{DD}$=7.0V, SCK=GND	500			ns
Vstart	Minimum Operating Voltage of Voltage Detector			0.9	1.3	V

●R5101G004A   Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V_{DD}	Operating Voltage				10	V
Iss-On	Supply Current (WDT active)	V_{DD}=CE=7.0V		7	20	μA
Iss-Off	Supply Current (WDT inactive)	V_{DD}=7.0V, CE=GND		8	24	μA
V_{OUT}	Output Voltage	VDD=7.0V,I_{OUT}=10mA	4.875	5.000	5.125	V
I_{OUT}	Output Current	V_{DD}=7.0V	50			mA
V_{DIF}	Dropout Voltage	I_{OUT}=30mA	100	350	650	mV
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{DD}=7.0V 1mA≤I_{OUT}≤50mA		50	100	mV
$\Delta V_{OUT}/\Delta V_{DD}$	Line Regulation	I_{OUT}=10mA V_{OUT}+0.5V≤V_{DD}≤10V		0.1	0.2	%/V
Ilim	Current Limit (Short mode)	V_{OUT}=0V	10	50	100	mA
$\Delta V_{OUT}/\Delta Topt$	Output Voltage Temperature Coefficient	I_{OUT}=10mA -40°C≤Topt≤85°C		±100		ppm/°C
-V_{DET}	Detector Threshold		2.145	2.200	2.255	V
V_{HYS}	Hysteresis Range		0.066	0.110	0.154	V
V_{DETMGN}	Regulator Voltage Margin against Released Voltage	V_{OUT}-((-V_{DET})+V_{HYS}), I_{OUT}=10mA	0.02			V
Δ-$V_{DET}/\Delta Topt$	Detector Threshold Temperature Coefficient	-40°C≤Topt≤85°C		±100		ppm/°C
tpr	Reset Delay Time	V_{DD}=7.0V, CD=0.001μF	7	14	21	ms
twd	Watch Time of WDT	V_{DD}=7.0V, CW=0.01μF	50	100	150	ms
twr	Reset Hold Time of WDT	V_{DD}=7.0V, CW=0.01μF	5	10	15	ms
V_{IHSCK}	SCK Input Voltage " H "	V_{DD}=7.0V	0.8×V_{OUT}		V_{DD}	V
V_{ILSCK}	SCK Input Voltage " L "	V_{DD}=7.0V	0		0.2×V_{OUT}	V
V_{IHCE}	CE Input Voltage " H "		1.2		V_{DD}	V
V_{ILCE}	CE Input Voltage " L "		0		0.2	V
I_{IHSCK}	SCK Input Current " H "	V_{DD}=SCK=7.0V	-1		1	μA
I_{ILSCK}	SCK Input Current " L "	V_{DD}=7.0V, SCK=GND	-1		1	μA
Rpu	CE Pull-up Resistance		2	4	10	MΩ
I_{CD}	CD Pin Output Current	V_{DD}=1.3V, V_{DS}=0.5V	1	2		mA
I_{CTW}	CTW Pin Output Current	V_{DD}=1.3V, V_{DS}=0.5V	1	2		mA
$I_{\overline{RESET}}$	$\overline{RESET}$ Pin Output Current	V_{DD}=1.3V, V_{DS}=0.5V	1	2		mA
Ileak	RESET Pin Leakage Current	VDD=10.0V,CE=GND,VDS=12.0V	-1		1	μA
tsckw	SCK Input Pulse Width	V_{DD}=7.0V, SCK=GND	500			ns
Vstart	Minimum Operating Voltage of Voltage Detector			0.9	1.3	V

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●R5101G005A   Topt=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V$_{DD}$	Operating Voltage				10	V
Iss-On	Supply Current (WDT active)	V$_{DD}$=CE=4.8V		5	15	μA
Iss-Off	Supply Current (WDT inactive)	V$_{DD}$=4.8V, CE=GND		6	18	μA
V$_{OUT}$	Output Voltage	V$_{DD}$=4.8V, I$_{OUT}$=10mA	2.730	2.800	2.870	V
I$_{OUT}$	Output Current	V$_{DD}$=4.8V, I$_{OUT}$=10mA	50			mA
V$_{DIF}$	Dropout Voltage	I$_{OUT}$=10mA	100	350	650	mV
ΔV$_{OUT}$/ ΔI$_{OUT}$	Load Regulation	V$_{DD}$=4.8V 1mA≤I$_{OUT}$≤50mA		50	100	mV
ΔV$_{OUT}$/ ΔV$_{DD}$	Line Regulation	I$_{OUT}$=10mA V$_{OUT}$+0.5V≤V$_{DD}$≤10V		0.1	0.2	%/V
Ilim	Current Limit (Short mode)	V$_{OUT}$=0V	10	50	100	mA
ΔV$_{OUT}$/ ΔTopt	Output Voltage Temperature Coefficient	I$_{OUT}$=10mA -40°C≤Topt≤85°C		±100		ppm/ °C
-V$_{DET}$	Detector Threshold		2.340	2.400	2.460	V
V$_{HYS}$	Hysteresis Range		0.072	0.120	0.168	V
V$_{DETMGN}$	Regulator Voltage Margin against Released Voltage	V$_{OUT}$-((-V$_{DET}$)+V$_{HYS}$), I$_{OUT}$=10mA	0.02			V
Δ-V$_{DET}$/ ΔTopt	Detector Threshold Temperature Coefficient	-40°C≤Topt≤85°C		±100		ppm/ °C
tpr	Reset Delay Time	V$_{DD}$=4.8V, CD=0.001μF	7	14	21	ms
twd	Watch Time of WDT	V$_{DD}$=4.8V, CW=0.01μF	50	100	150	ms
twr	Reset Hold Time of WDT	V$_{DD}$=4.8V, CW=0.01μF	5	10	15	ms
V$_{IHSCK}$	SCK Input Voltage " H "	V$_{DD}$=4.8V	0.8×V$_{OUT}$		V$_{DD}$	V
V$_{ILSCK}$	SCK Input Voltage " L "	V$_{DD}$=4.8V	0		0.1×V$_{OUT}$	V
V$_{IHCE}$	CE Input Voltage " H "		1.2		V$_{DD}$	V
V$_{ILCE}$	CE Input Voltage " L "		0		0.2	V
I$_{IHSCK}$	SCK Input Current " H "	V$_{DD}$=SCK=4.8V	-1		1	μA
I$_{ILSCK}$	SCK Input Current " L "	V$_{DD}$=4.8V, SCK=GND	-1		1	μA
Rpu	CE Pull-up Resistance			4		MΩ
I$_{CD}$	CD Pin Output Current	V$_{DD}$=1.3V, V$_{DS}$=0.5V	1	2		mA
I$_{CTW}$	CTW Pin Output Current	V$_{DD}$=1.3V, V$_{DS}$=0.5V	1	2		mA
I$_{\overline{RESET}}$	$\overline{RESET}$ Pin Output Current	V$_{DD}$=1.3V, V$_{DS}$=0.5V	1	2		mA
Ileak	$\overline{RESET}$ Pin Leakage Current	VDD=10.0V,CE=GND,VDS=12.0V	-1		1	μA
tsckw	SCK Input Pulse Width	V$_{DD}$=4.8V, SCK=GND	500			ns
Vstart	Minimum Operating Voltage of Voltage Detector			0.9	1.3	V

■ TYPICAL APPLICATION

R5101GXXX Series

Micro Processor

SCK

CD(0.001μF) — CD

CTW

CW(0.01μF) — VDD

1μF

RESET

CE

GND   510kΩ

VOUT   1μF

DOUT

RESET

VDD
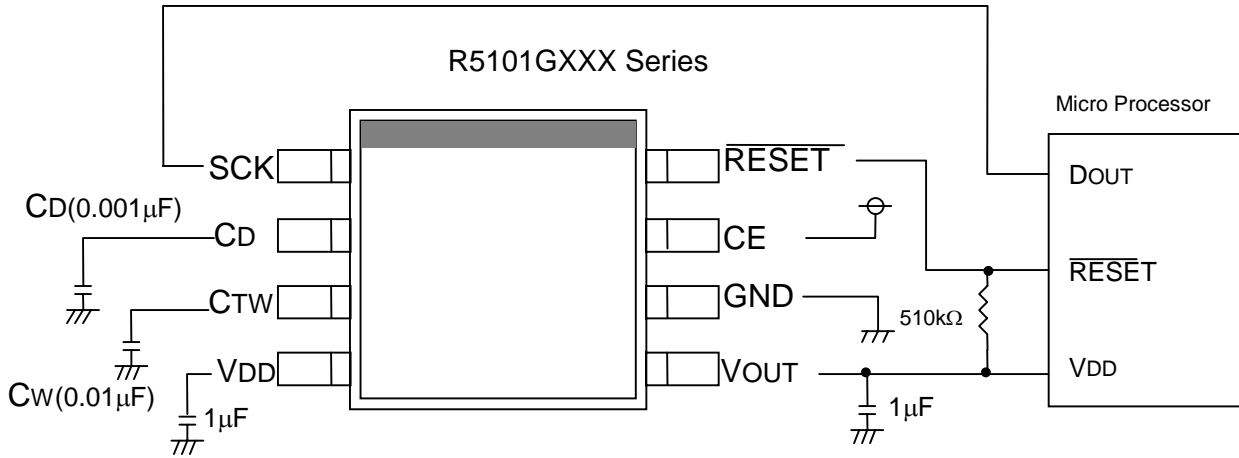
■ TECHNICAL NOTES

Use 0.01μF or more value of an external capacitor, CW for setting monitoring time of watchdog timer.

Use 1 or 2.2μF capacitor between VDD and GND, and between VOUT and GND and make its wiring as short as possible.

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■ OPERATION DIAGRAM

Detector Threshold Hysteresis

VDD
Vstart

+Vdet
-Vdet
VOUT

Vref2H
CD
tpr

Vref2H
CTW
twd twr
Vref2L

SCK
tsckw

CE

$\overline{\text{RESET}}$

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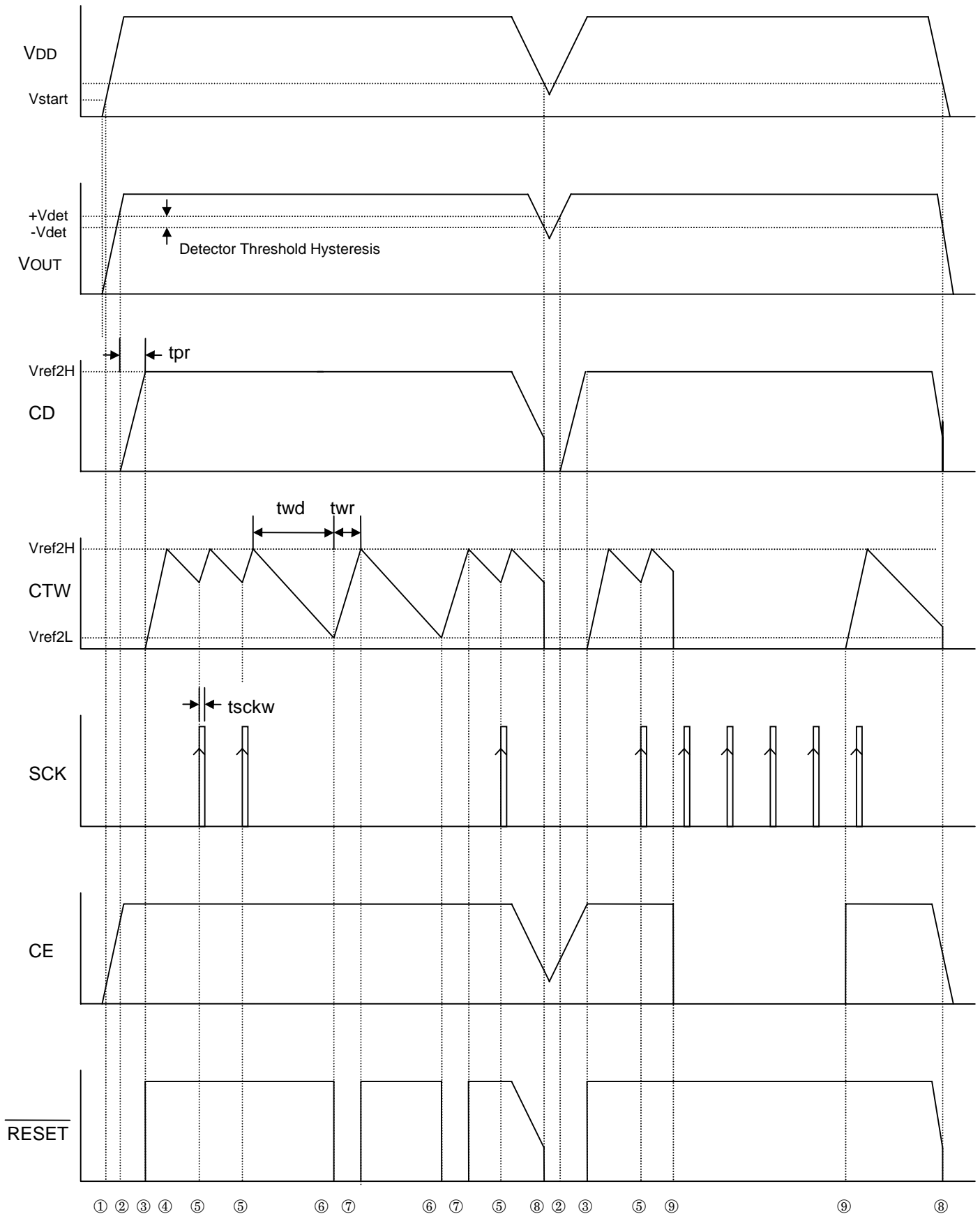
■ OPERATION

① When V$_{DD}$ is turned on and Input Voltage reaches Vstart (nearly equal 0.8V), the output of $\overline{\text{RESET}}$ pin becomes "L" level.

② An External Capacitor starts to be charged through the C$_D$ pin when an Output Voltage of the Voltage Regulator, V$_{OUT}$, crosses the Released Voltage , +V$_{DET}$, from Lower to Higher . The $\overline{\text{VRESET}}$ is kept "L" level until Voltage of the C$_D$ pin , V$_{CD}$, reaches to the Vref2H , about 1.0V , and after that the $\overline{\text{VRESET}}$ becomes to "H" level.

∗ tPR : Time interval between the timing of starting edge of forcing voltage to VDD pin and the timing of reverse the voltage level of $\overline{\text{VRESET}}$.

tPR can be set by connecting an external capacitor to C$_D$ pin, tPR can be calculated as shown below;

tPR (ms) ≈ 13000× C$_D$ (μF) ; C$_D$ means a value of an external capacitor connected to C$_D$ pin.

③ When the voltage level of V$_{CD}$ reaches to the Vref2H, the external capacitor starts to be charged through the C$_{TW}$ pin and the watchdog timer begins to operate.

④ The operation mode for the external capacitor changes from charging mode to discharging mode through C$_{TW}$ pin when the voltage level of C$_{TW}$ pin , V$_{CTW}$, reaches to the Vref2H.

⑤ While the C$_{TW}$ pin is on the discharging mode, if a clock pulse is entered (synchronous with a rising edge of the pulse), the operation mode of C$_{TW}$ pin changes from charging mode to discharging mode. And the external capacitor connected to C$_{TW}$ pin is charged until its voltage level reaches to Vref2H.

⑥ While the C$_{TW}$ pin is on the discharging mode, if V$_{CTW}$ level drops to Vref2L, about 0.2V without clock pulse to CLK pin, the voltage level of Reset pin becomes from "H" to "L".

∗ Watch Time of the watchdog timer , tWD , : Discharging Time of C$_{TW}$ pin level from Vref2H to Vref2L

tWD can be set by connecting an external capacitor to C$_W$ pin, tWD can be calculated as shown below;

tWD (ms) ≈ 10000× C$_W$ (μF); C$_W$ means a value of an external capacitor connected to C$_W$ pin.

⑦ C$_{TW}$ pin is changed to charging mode from discharging mode when the Reset signal is generated.

∗ Reset time of the watchdog timer , tWR , : Time interval between Charging time of the C$_{TW}$ pin from Vref2L to Vref2H. tWR can be calculated by the next equation as shown below;

tWR (ms) ≈ tWD/10

⑧ The Output Voltage level of $\overline{\text{Reset}}$ pin becomes from "H" to "L", or a Reset signal is generated when an output voltage of the Voltage Regulator drops to a level at equal or less than -Vdet.

⑨ The watchdog timer will be halted when a Voltage level of CE pin becomes to "L". In this case, only the watchdog timer is stopped and monitoring the output voltage is continued. After that, if the voltage level of CE pin becomes to "H", C$_{TW}$ pin starts to be on charging mode.

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■ TEST CIRCUITS
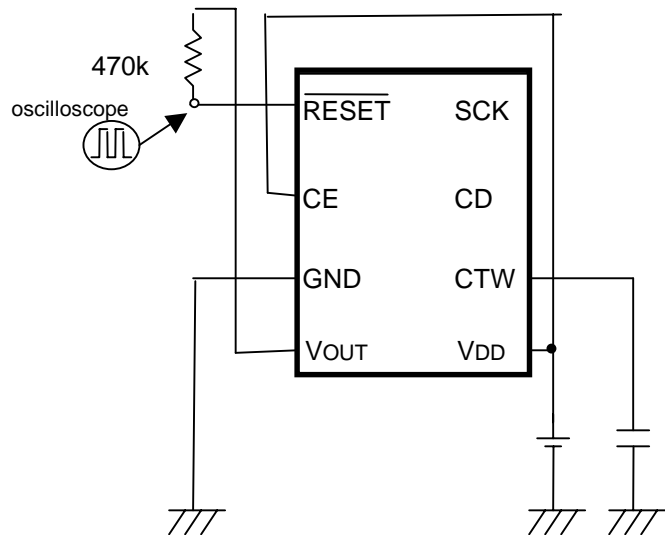
Test Circuit of Supply Current
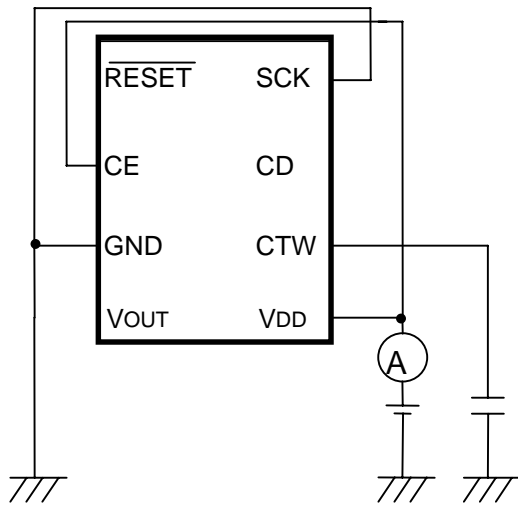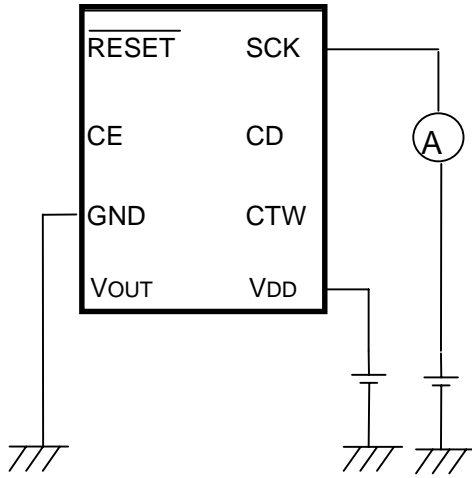
Test Circuit of Output Voltage
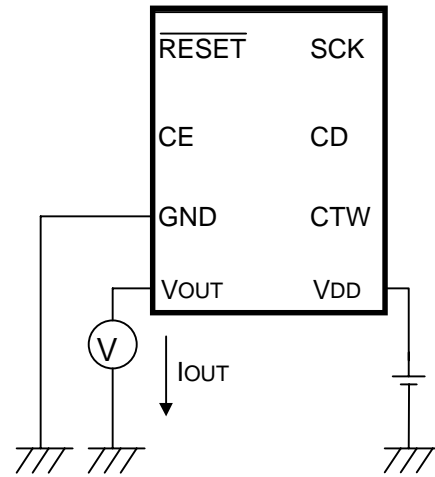
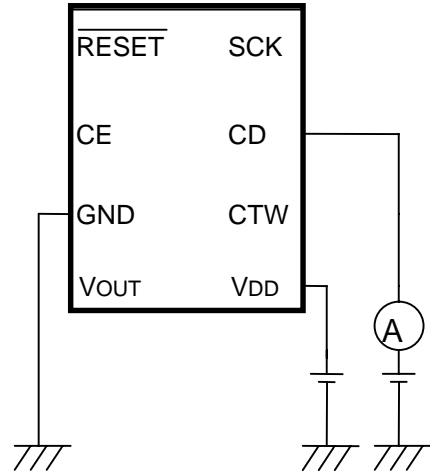Test Circuit of Detector Threshold(V_{DET})
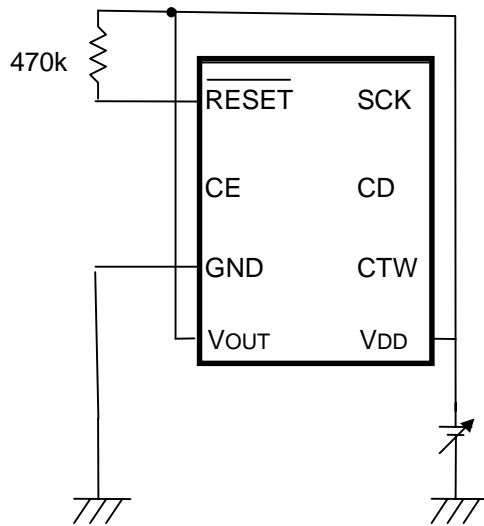
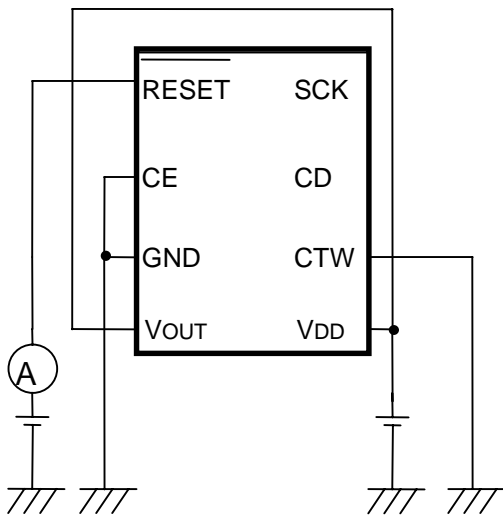Test Circuit of Monitoring Time of WDT and RESET Time

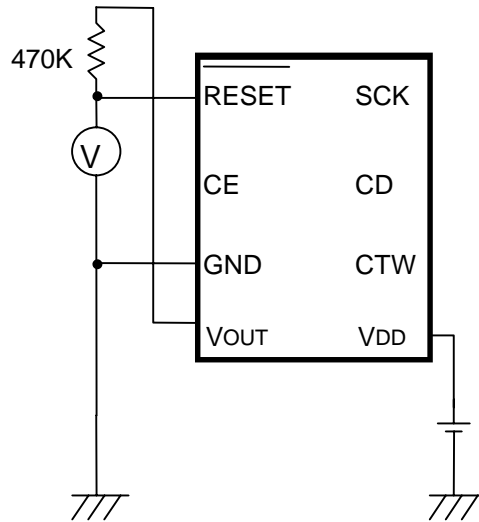Test Circuit of SCK Input Current

Test Circuit of Output Current

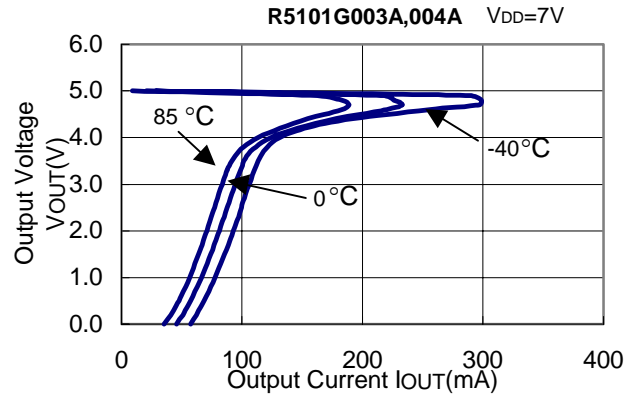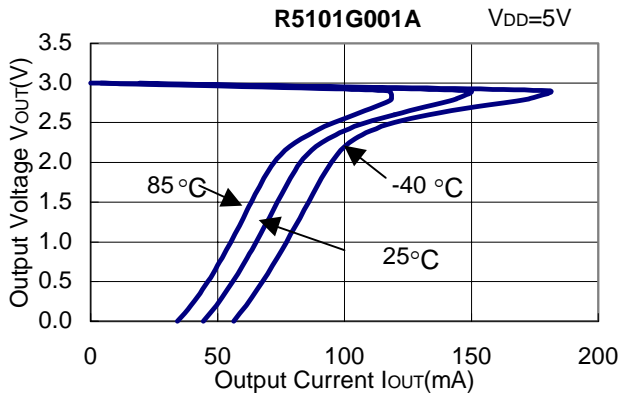

Test Circuit of RESET Output leakage Current

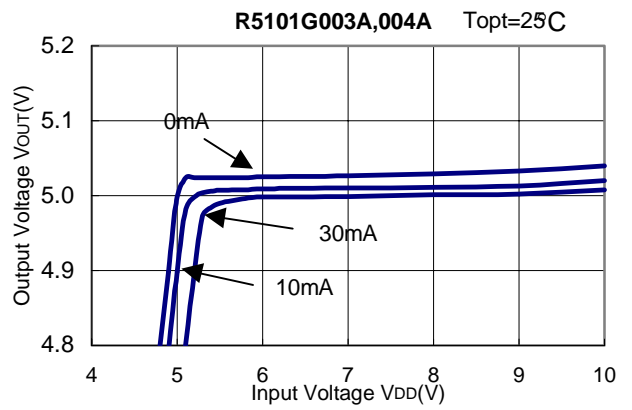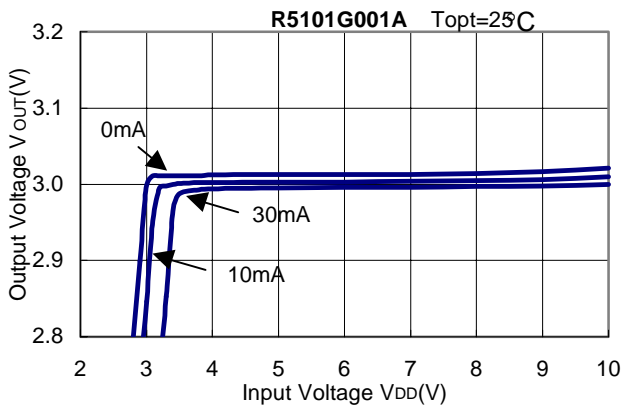Test Circuit of Minimum Input Voltage
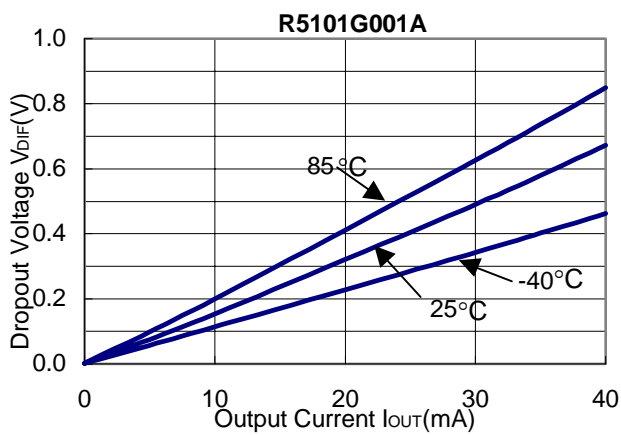for RESET Output

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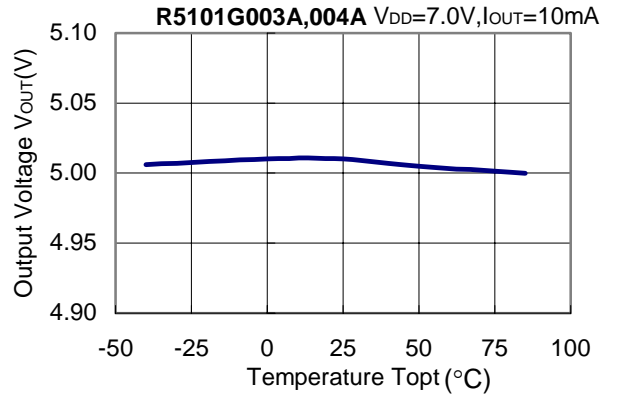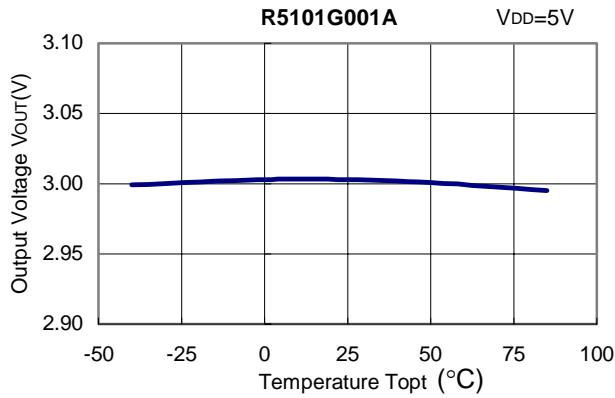## ■ TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

R5101G001A   VDD=5V

Output Voltage VOUT(V) vs Output Current IOUT(mA)

85 °C, -40 °C, 25°C

R5101G003A,004A   VDD=7V

Output Voltage VOUT(V) vs Output Current IOUT(mA)

85 °C, 0 °C, -40°C

2) Output Voltage vs. Input Voltage

R5101G001A   Topt=25°C

Output Voltage VOUT(V) vs Input Voltage VDD(V)

0mA, 30mA, 10mA

R5101G003A,004A   Topt=25°C

Output Voltage VOUT(V) vs Input Voltage VDD(V)

0mA, 30mA, 10mA

3) Dropout Voltage vs. Output Current

R5101G001A

Dropout Voltage VDIF(V) vs Output Current IOUT(mA)

85 °C, 25°C, -40°C

R5101G003A, 004A   VDD=7.0V

Dropout Voltage VDIF(V) vs Output Current IOUT(mA)

85 °C, 25 °C, -40°C
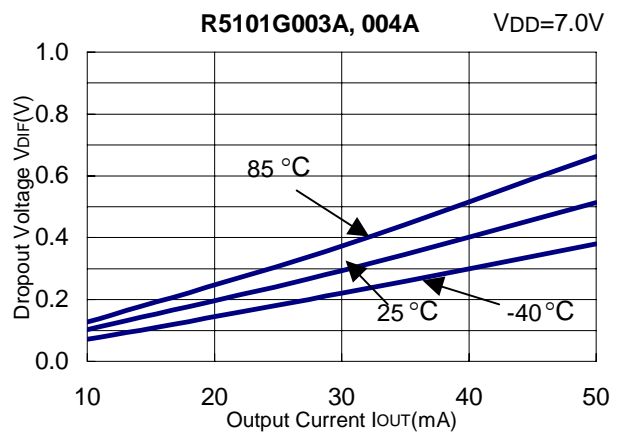
4) Output Voltage vs. Temperature

R5101G001A $V_{DD}=5V$

Output Voltage V_{OUT}(V) vs. Temperature Topt (°C)

R5101G003A,004A $V_{DD}=7.0V, I_{OUT}=10mA$

Output Voltage V_{OUT}(V) vs. Temperature Topt (°C)

5) RESET Pin Voltage vs. Input Voltage

R5101G001A Pull-up 510kΩ

RESET Pin Voltage V_{RESET}(V) vs. Input Voltage V_{DD}(V)

-40 °C
85°C
25 °C
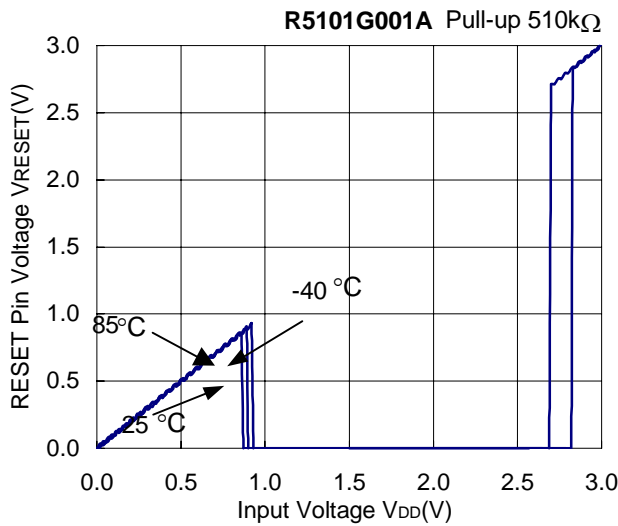
6) Detector Threshold vs. Temperature
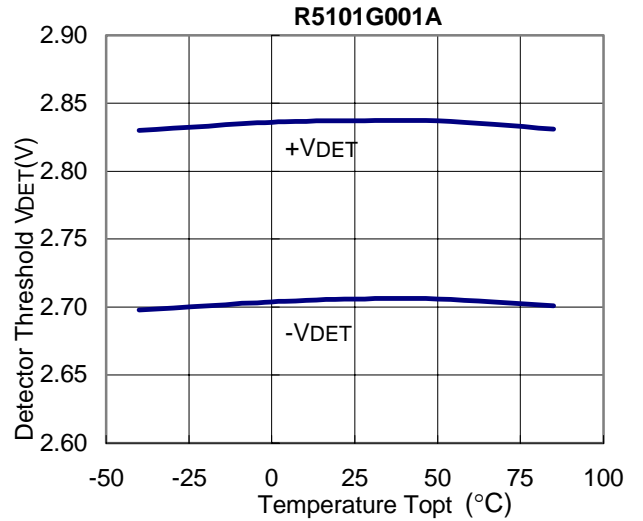
R5101G001A

Detector Threshold V_{DET}(V) vs. Temperature Topt (°C)

+V_{DET}
-V_{DET}

7) CD Pin Output Current vs. Input Voltage

R5101G001A $V_{DS}=0.5V$

CD Output Current I_{OUT}(mA) vs. Input Voltage V_{DD}(V)

-40 °C
25 °C
85°C

8) CTW Pin Output Current vs. Input Voltage

R5101G001A $V_{DS}=0.5V$

CTW Output Current I_{OUT}(mA) vs. Input Voltage V_{DD}(V)

-40 °C
25 °C
85 °C

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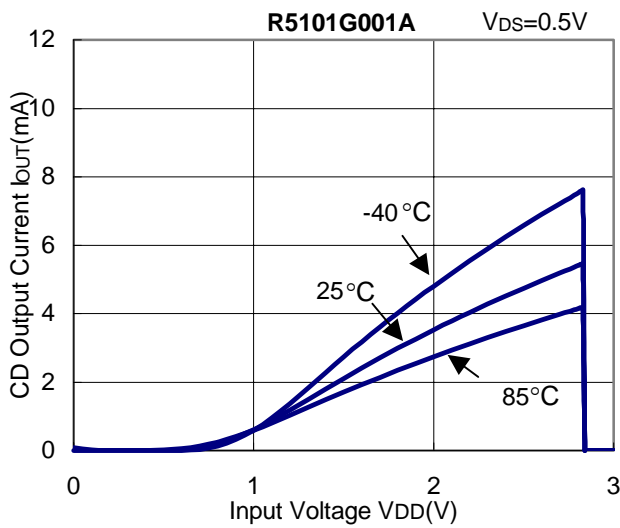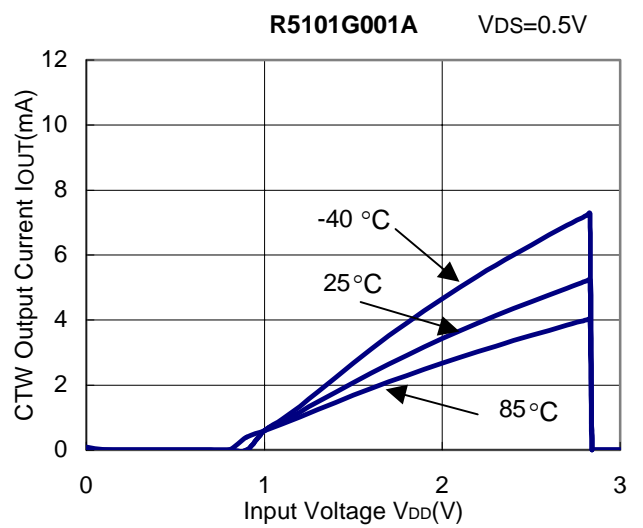
9) RESET Pin Output Current vs. Input Voltage

R5101G001A   VDS=0.5V
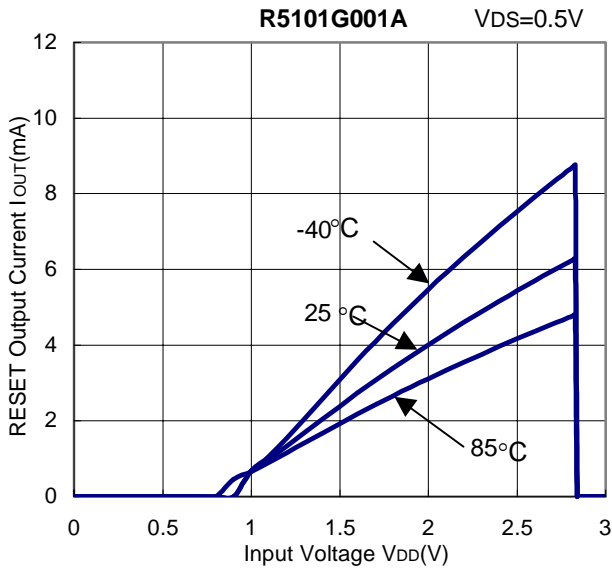
10) Delay Time of Released Voltage vs. Temperature

R5101G001A
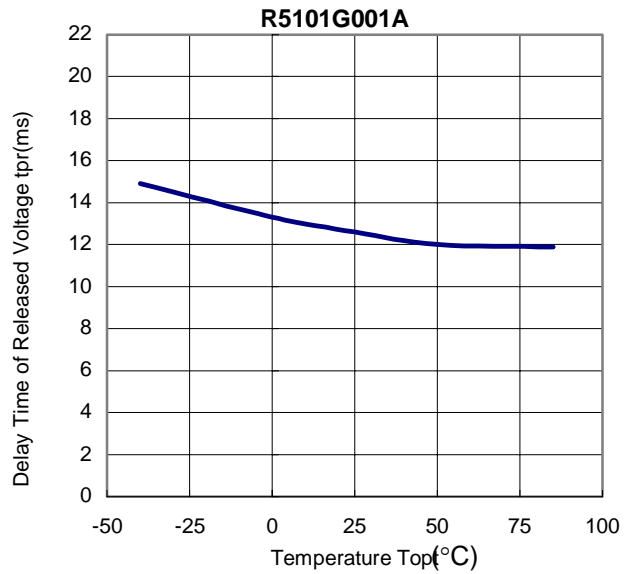
11) Monitoring Time of Watchdog Timer vs. Temperature
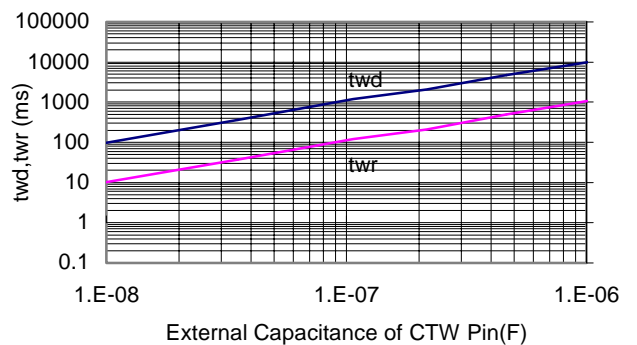
R5101G001A
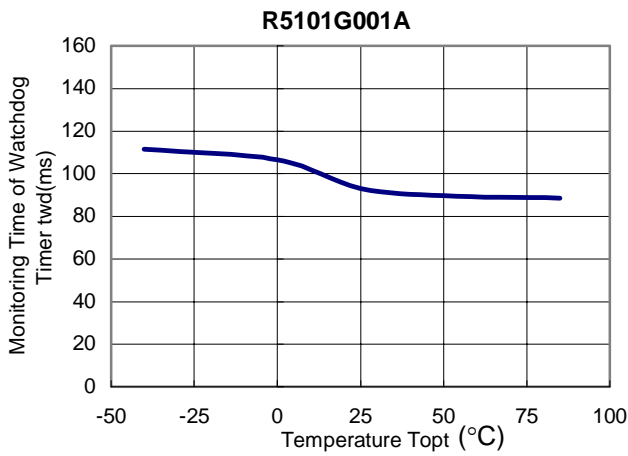
12) Reset Time of Watchdog Timer vs. Temperature
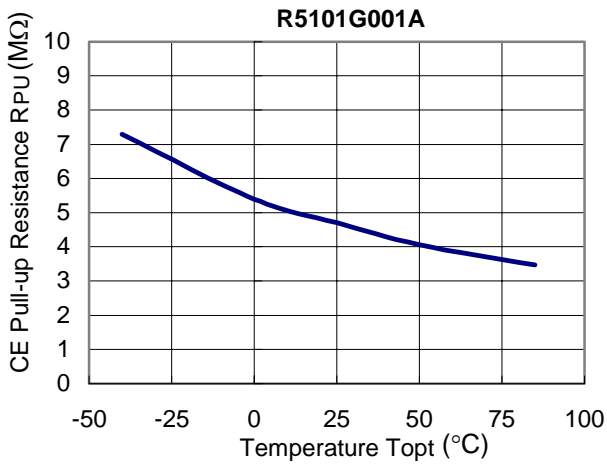
R5101G001A
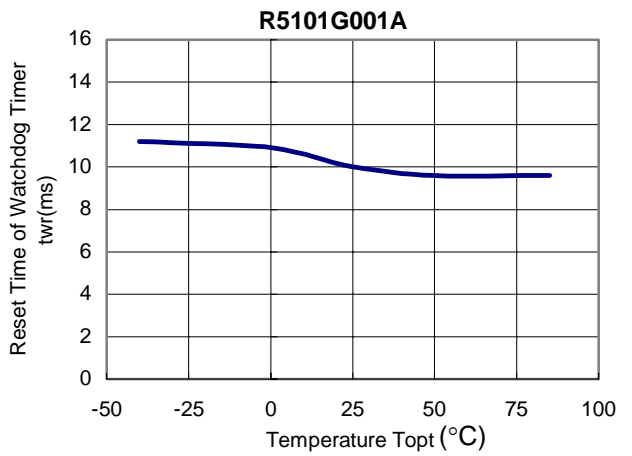
13) tpr vs. External Capacitance of Cd Pin
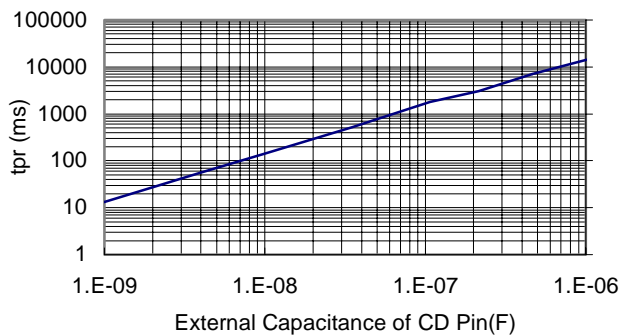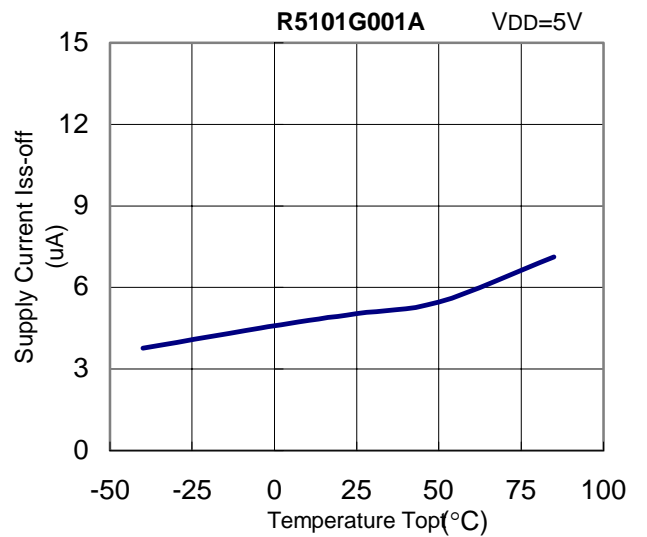

14) twd, twr vs. External Capacitance of Ctw Pin
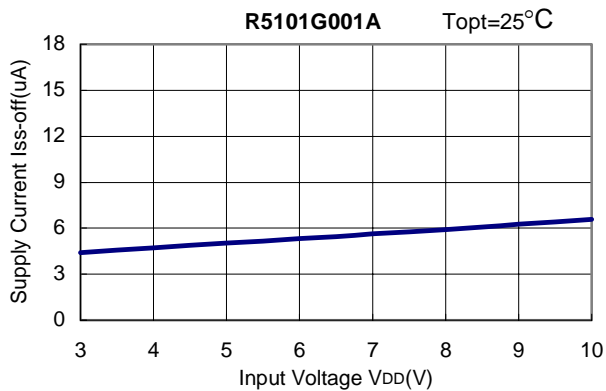

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15) CE Pull-up Resistance vs. Temperature

R5101G001A

CE Pull-up Resistance RPU (MΩ) vs. Temperature Topt (°C)

16) Supply Current vs. Input Voltage (WDT ON)

R5101G001A   Topt=25°C

Supply Current Iss-on(uA) vs. Input Voltage VDD(V)

17) Supply Current vs. Temperature (WDT ON)

R5101G001A   VDD=5V

Supply Current Iss-off (uA) vs. Temperature Topt(°C)

18) Supply Current vs. Input Voltage (WDT OFF)

R5101G001A   Topt=25°C

Supply Current Iss-off(uA) vs. Input Voltage VDD(V)

19) Supply Current vs. Temperature (WDT OFF)

R5101G001A   VDD=5V

Supply Current Iss-on(uA) vs. Temperature Topt (°C)

RICOH