

## ■ 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(CD).

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(CTW).

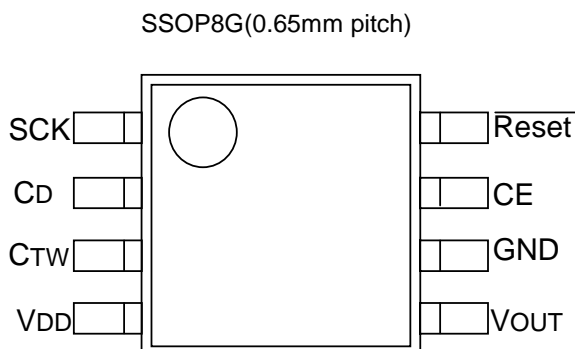
## ■ FEATURES

- 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

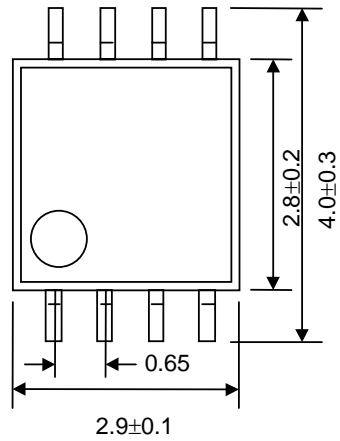
- Power source for microprocessors

## ■ PIN CONFIGURATION



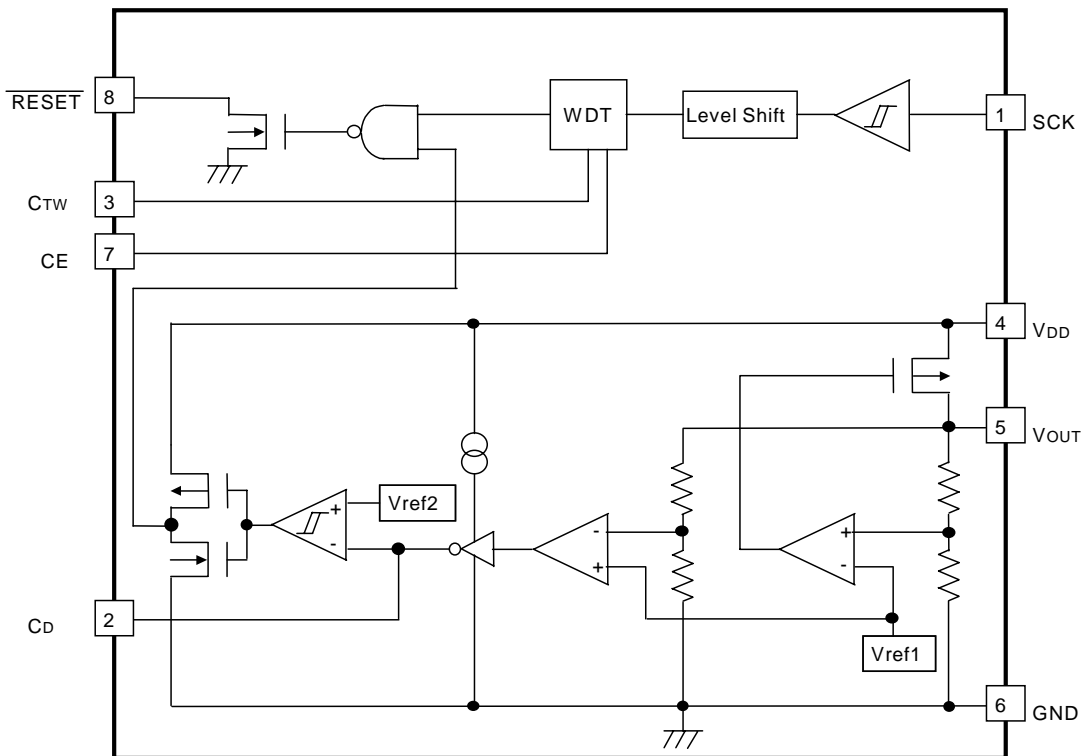
## ■ PACKAGE DIMENSIONS

SSOP8G



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	VDD	Power supply Pin
5	VOUT	Output Pin for Voltage Regulator
6	GND	Ground Pin
7	CE	Control Switch Pin for Watchdog timer ( "H" active, "L" inactive)
8	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

T<sub>opt</sub>=25°C, V<sub>ss</sub>=0V

Symbol	Item	Rating	Unit	
V <sub>DD</sub>	Supply Voltage	-0.3~12	V	
V <sub>CD</sub>	Output Voltage	Voltage of CD Pin	V <sub>ss</sub> -0.3~V <sub>DD</sub> +0.3	V
V <sub>CTW</sub>		Voltage of CTW Pin	V <sub>ss</sub> -0.3~V <sub>DD</sub> +0.3	V
V <sub>VOUT</sub>		Voltage of V <sub>OUT</sub> Pin	V <sub>ss</sub> -0.3~V <sub>DD</sub> +0.3	V
V <sub>RESET</sub>		Voltage of RESET Pin	V <sub>ss</sub> -0.3~12	V
V <sub>CE</sub>	Input Voltage	Voltage of CE Pin	V <sub>ss</sub> -0.3~V <sub>DD</sub> +0.3	V
V <sub>SCK</sub>		Voltage of SCK Pin	V <sub>ss</sub> -0.3~V <sub>DD</sub> +0.3	V
I <sub>OUT</sub>	Output Current	Current of V <sub>OUT</sub> Pin	150	mA
I <sub>RESET</sub>		Current of RESET Pin	10	mA
P <sub>D</sub>	Power Dissipation	300	mW	
T <sub>opt</sub>	Operating Temperature Range	-40~+85	°C	
T <sub>stg</sub>	Storage Temperature Range	-55~+125	°C	

## ■ ELECTRICAL CHARACTERISTICS

●R5101G001A

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V <sub>DD</sub>	Operating Voltage				10	V
I <sub>ss-On</sub>	Supply Current (WDT active)	V <sub>DD</sub> =CE=5.0V		5	15	μA
I <sub>ss-Off</sub>	Supply Current (WDT inactive)	V <sub>DD</sub> =5.0V, CE=GND		6	18	μA
V <sub>OUT</sub>	Output Voltage	V <sub>DD</sub> =5.0V, I <sub>OUT</sub> =10mA	2.925	3.000	3.075	V
I <sub>OUT</sub>	Output Current	V <sub>DD</sub> =5.0V	100			mA
V <sub>DIF</sub>	Dropout Voltage	I <sub>OUT</sub> =30mA	150	500	850	mV
ΔV <sub>OUT</sub> / ΔI <sub>OUT</sub>	Load Regulation	V <sub>DD</sub> =5.0V 1mA ≤ I <sub>OUT</sub> ≤ 50mA		50	100	mV
ΔV <sub>OUT</sub> / ΔV <sub>DD</sub>	Line Regulation	I <sub>OUT</sub> =10mA V <sub>OUT</sub> +0.5V ≤ V <sub>DD</sub> ≤ 10V		0.1	0.2	%/V
I <sub>lim</sub>	Current Limit (Short mode)	V <sub>OUT</sub> =0V	10	50	100	mA
ΔV <sub>OUT</sub> / ΔT <sub>opt</sub>	Output Voltage Temperature Coefficient	I <sub>OUT</sub> =10mA -40°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/ °C
-V <sub>DET</sub>	Detector Threshold		2.633	2.700	2.767	V
V <sub>HYS</sub>	Hysteresis Range		0.081	0.135	0.189	V
V <sub>DETMGN</sub>	Regulator Voltage Margin against Released Voltage	V <sub>OUT</sub> -((-V <sub>DET</sub> )+V <sub>HYS</sub> ), I <sub>OUT</sub> =10mA	0.02			V
Δ-V <sub>DET</sub> / ΔT <sub>opt</sub>	Detector Threshold Temperature Coefficient	-40°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/ °C
t <sub>pr</sub>	Reset Delay Time	V <sub>DD</sub> =5.0V, CD=0.001μF	7	14	21	ms
t <sub>wd</sub>	Watch Time of WDT	V <sub>DD</sub> =5.0V, CW=0.01μF	50	100	150	ms
t <sub>wr</sub>	Reset Hold Time of WDT	V <sub>DD</sub> =5.0V, CW=0.01μF	5	10	15	ms
V <sub>IHSCK</sub>	SCK Input Voltage " H "	V <sub>DD</sub> =5.0V	0.8×V <sub>OUT</sub>		V <sub>DD</sub>	V
V <sub>ILSCK</sub>	SCK Input Voltage " L "	V <sub>DD</sub> =5.0V	0		0.2×V <sub>OUT</sub>	V
V <sub>IHCE</sub>	CE Input Voltage " H "		1.2		V <sub>DD</sub>	V
V <sub>ILCE</sub>	CE Input Voltage " L "		0		0.2	V
I <sub>IHSCK</sub>	SCK Input Current " H "	V <sub>DD</sub> =SCK=5.0V	-1		1	μA
I <sub>ILSCK</sub>	SCK Input Current " L "	V <sub>DD</sub> =5.0V, SCK=GND	-1		1	μA
R <sub>pu</sub>	CE Pull-up Resistance		2	4	10	MΩ
I <sub>CD</sub>	CD Pin Output Current	V <sub>DD</sub> =1.3V, V <sub>DS</sub> =0.5V	1	2		mA
I <sub>CTW</sub>	CTW Pin Output Current	V <sub>DD</sub> =1.3V, V <sub>DS</sub> =0.5V	1	2		mA
I <sub>RESET</sub>	RESET Pin Output Current	V <sub>DD</sub> =1.3V, V <sub>DS</sub> =0.5V	1	2		mA
I <sub>leak</sub>	RESET Pin Leakage Current	V <sub>DD</sub> =10.0V, CE=GND, V <sub>DS</sub> =12.0V	-1		1	μA
t <sub>sckw</sub>	SCK Input Pulse Width	V <sub>DD</sub> =5.0V, CW=0.01μF	500			ns
V <sub>start</sub>	Minimum Operating Voltage of Voltage Detector			0.9	1.3	V

●R5101G002A

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V <sub>DD</sub>	Operating Voltage				10	V
I <sub>ss-On</sub>	Supply Current (WDT active)	V <sub>DD</sub> =CE5.3V		5	15	μA
I <sub>ss-Off</sub>	Supply Current (WDT inactive)	V <sub>DD</sub> =5.3V, CE=GND		6	18	μA
V <sub>OUT</sub>	Output Voltage	V <sub>DD</sub> =5.3V, I <sub>OUT</sub> =10mA	3.218	3.300	3.382	V
I <sub>OUT</sub>	Output Current	V <sub>DD</sub> =5.3V	50			mA
V <sub>DIF</sub>	Dropout Voltage	I <sub>OUT</sub> =30mA	100	500	650	mV
ΔV <sub>OUT</sub> / ΔI <sub>OUT</sub>	Load Regulation	V <sub>DD</sub> =5.3V 1mA≤I <sub>OUT</sub> ≤50mA		50	100	mV
ΔV <sub>OUT</sub> / ΔV <sub>DD</sub>	Line Regulation	I <sub>OUT</sub> =10mA V <sub>OUT</sub> +0.5V≤V <sub>DD</sub> ≤10V		0.1	0.2	%/V
I <sub>lim</sub>	Current Limit (Short mode)	V <sub>OUT</sub> =0V	10	50	100	mA
ΔV <sub>OUT</sub> / ΔT <sub>opt</sub>	Output Voltage Temperature Coefficient	I <sub>OUT</sub> =10mA -40°C≤T <sub>opt</sub> ≤85°C		±100		ppm/ °C
-V <sub>DET</sub>	Detector Threshold		2.925	3.000	3.075	V
V <sub>HYS</sub>	Hysteresis Range		0.090	0.150	0.210	V
V <sub>DETMGN</sub>	Regulator Voltage Margin against Released Voltage	V <sub>OUT</sub> -((-V <sub>DET</sub> )+V <sub>HYS</sub> ), I <sub>OUT</sub> =10mA	0.02			V
Δ-V <sub>DET</sub> / ΔT <sub>opt</sub>	Detector Threshold Temperature Coefficient	-40°C≤T <sub>opt</sub> ≤85°C		±100		ppm/ °C
t <sub>pr</sub>	Reset Delay Time	V <sub>DD</sub> =5.3V, CD=0.001μF	7	14	21	ms
t <sub>wd</sub>	Watch Time of WDT	V <sub>DD</sub> =5.3V, CW=0.01μF	50	100	150	ms
t <sub>wr</sub>	Reset Hold Time of WDT	V <sub>DD</sub> =5.3V, CW=0.01μF	5	10	15	ms
V <sub>IHSCK</sub>	SCK Input Voltage " H "	V <sub>DD</sub> =5.3V	0.8×V <sub>OUT</sub>		V <sub>DD</sub>	V
V <sub>ILSCK</sub>	SCK Input Voltage " L "	V <sub>DD</sub> =5.3V	0		0.2×V <sub>OUT</sub>	V
V <sub>IHCE</sub>	CE Input Voltage " H "		1.2		V <sub>DD</sub>	V
V <sub>ILCE</sub>	CE Input Voltage " L "		0		0.2	V
I <sub>IHSCK</sub>	SCK Input Current " H "	V <sub>DD</sub> =SCK=5.3V	-1		1	μA
I <sub>ILSCK</sub>	SCK Input Current " L "	V <sub>DD</sub> =5.3V, SCK=GND	-1		1	μA
R <sub>pu</sub>	CE Pull-up Resistance			4		MΩ
I <sub>CD</sub>	CD Pin Output Current	V <sub>DD</sub> =1.3V, V <sub>DS</sub> =0.5V	1	2		mA
I <sub>CTW</sub>	CTW Pin Output Current	V <sub>DD</sub> =1.3V, V <sub>DS</sub> =0.5V	1	2		mA
I <sub>RESET</sub>	RESET Pin Output Current	V <sub>DD</sub> =1.3V, V <sub>DS</sub> =0.5V	1	2		mA
I <sub>leak</sub>	RESET Pin Leakage Current	V <sub>DD</sub> =10.0V, CE=GND, V <sub>DS</sub> =12.0V	-1		1	μA
t <sub>sckw</sub>	SCK Input Pulse Width	V <sub>DD</sub> =5.3V, SCK=GND	500			ns
V <sub>start</sub>	Minimum Operating Voltage of Voltage Detector			0.9	1.3	V

●R5101G003A

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V <sub>DD</sub>	Operating Voltage				10	V
I <sub>SS-On</sub>	Supply Current (WDT active)	V <sub>DD</sub> =CE=7.0V		7	20	μA
I <sub>SS-Off</sub>	Supply Current (WDT inactive)	V <sub>DD</sub> =7.0V, CE=GND		8	24	μA
V <sub>OUT</sub>	Output Voltage	V <sub>DD</sub> =7.0V, I <sub>OUT</sub> =10mA	4.875	5.000	5.125	V
I <sub>OUT</sub>	Output Current	V <sub>DD</sub> =7.0V	50			mA
V <sub>DIF</sub>	Dropout Voltage	I <sub>OUT</sub> =30mA	100	350	600	mV
ΔV <sub>OUT</sub> / ΔI <sub>OUT</sub>	Load Regulation	V <sub>DD</sub> =7.0V 1mA≤I <sub>OUT</sub> ≤50mA		50	100	mV
ΔV <sub>OUT</sub> / ΔV <sub>DD</sub>	Line Regulation	I <sub>OUT</sub> =10mA V <sub>OUT</sub> +0.5V≤V <sub>DD</sub> ≤10V		0.1	0.2	%/V
I <sub>lim</sub>	Current Limit (Short mode)	V <sub>OUT</sub> =0V	10	50	100	mA
ΔV <sub>OUT</sub> / ΔT <sub>opt</sub>	Output Voltage Temperature Coefficient	I <sub>OUT</sub> =10mA -40°C≤T <sub>opt</sub> ≤85°C		±100		ppm/ °C
-V <sub>DET</sub>	Detector Threshold		4.388	4.500	4.590	V
V <sub>HYS</sub>	Hysteresis Range		0.135	0.225	0.315	V
V <sub>DETMGN</sub>	Regulator Voltage Margin against Released Voltage	V <sub>OUT</sub> -((-V <sub>DET</sub> )+V <sub>HYS</sub> ), I <sub>OUT</sub> =10mA	0.02			V
Δ-V <sub>DET</sub> / ΔT <sub>opt</sub>	Detector Threshold Temperature Coefficient	-40°C≤T <sub>opt</sub> ≤85°C		±100		ppm/ °C
t <sub>pr</sub>	Reset Delay Time	V <sub>DD</sub> =7.0V, CD=0.001μF	7	14	21	ms
t <sub>wd</sub>	Watch Time of WDT	V <sub>DD</sub> =7.0V, CW=0.01μF	50	100	150	ms
t <sub>wr</sub>	Reset Hold Time of WDT	V <sub>DD</sub> =7.0V, CW=0.01μF	5	10	15	ms
V <sub>IHSCK</sub>	SCK Input Voltage " H "	V <sub>DD</sub> =7.0V	0.8×V <sub>OUT</sub>		V <sub>DD</sub>	V
V <sub>ILSCK</sub>	SCK Input Voltage " L "	V <sub>DD</sub> =7.0V	0		0.2×V <sub>OUT</sub>	V
V <sub>IHCE</sub>	CE Input Voltage " H "		1.2		V <sub>DD</sub>	V
V <sub>ILCE</sub>	CE Input Voltage " L "		0		0.2	V
I <sub>IHSCK</sub>	SCK Input Current " H "	V <sub>DD</sub> =SCK=7.0V	-1		1	μA
I <sub>ILSCK</sub>	SCK Input Current " L "	V <sub>DD</sub> =7.0V, SCK=GND	-1		1	μA
R <sub>pu</sub>	CE Pull-up Resistance		2	4	10	MΩ
I <sub>CD</sub>	CD Pin Output Current	V <sub>DD</sub> =1.3V, V <sub>DS</sub> =0.5V	1	2		mA
I <sub>CTW</sub>	CTW Pin Output Current	V <sub>DD</sub> =1.3V, V <sub>DS</sub> =0.5V	1	2		mA
I <sub>RESET</sub>	RESET Pin Output Current	V <sub>DD</sub> =1.3V, V <sub>DS</sub> =0.5V	1	2		mA
I <sub>leak</sub>	RESET Pin Leakage Current	V <sub>DD</sub> =10.0V, CE=GND, V <sub>DS</sub> =12.0V	-1		1	μA
t <sub>sckw</sub>	SCK Input Pulse Width	V <sub>DD</sub> =7.0V, SCK=GND	500			ns
V <sub>start</sub>	Minimum Operating Voltage of Voltage Detector			0.9	1.3	V

## ●R5101G004A

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V <sub>DD</sub>	Operating Voltage				10	V
I <sub>ss-On</sub>	Supply Current (WDT active)	V <sub>DD</sub> =CE=7.0V		7	20	μA
I <sub>ss-Off</sub>	Supply Current (WDT inactive)	V <sub>DD</sub> =7.0V, CE=GND		8	24	μA
V <sub>OUT</sub>	Output Voltage	V <sub>DD</sub> =7.0V, I <sub>OUT</sub> =10mA	4.875	5.000	5.125	V
I <sub>OUT</sub>	Output Current	V <sub>DD</sub> =7.0V	50			mA
V <sub>DIF</sub>	Dropout Voltage	I <sub>OUT</sub> =30mA	100	350	650	mV
ΔV <sub>OUT</sub> / ΔI <sub>OUT</sub>	Load Regulation	V <sub>DD</sub> =7.0V 1mA≤I <sub>OUT</sub> ≤50mA		50	100	mV
ΔV <sub>OUT</sub> / ΔV <sub>DD</sub>	Line Regulation	I <sub>OUT</sub> =10mA V <sub>OUT</sub> +0.5V≤V <sub>DD</sub> ≤10V		0.1	0.2	%/V
I <sub>lim</sub>	Current Limit (Short mode)	V <sub>OUT</sub> =0V	10	50	100	mA
ΔV <sub>OUT</sub> / ΔT <sub>opt</sub>	Output Voltage Temperature Coefficient	I <sub>OUT</sub> =10mA -40°C≤T <sub>opt</sub> ≤85°C		±100		ppm/ °C
-V <sub>DET</sub>	Detector Threshold		2.145	2.200	2.255	V
V <sub>HYS</sub>	Hysteresis Range		0.066	0.110	0.154	V
V <sub>DETMGN</sub>	Regulator Voltage Margin against Released Voltage	V <sub>OUT</sub> -((-V <sub>DET</sub> )+V <sub>HYS</sub> ), I <sub>OUT</sub> =10mA	0.02			V
Δ-V <sub>DET</sub> / ΔT <sub>opt</sub>	Detector Threshold Temperature Coefficient	-40°C≤T <sub>opt</sub> ≤85°C		±100		ppm/ °C
t <sub>pr</sub>	Reset Delay Time	V <sub>DD</sub> =7.0V, CD=0.001μF	7	14	21	ms
t <sub>wd</sub>	Watch Time of WDT	V <sub>DD</sub> =7.0V, CW=0.01μF	50	100	150	ms
t <sub>wr</sub>	Reset Hold Time of WDT	V <sub>DD</sub> =7.0V, CW=0.01μF	5	10	15	ms
V <sub>IHSCK</sub>	SCK Input Voltage " H "	V <sub>DD</sub> =7.0V	0.8×V <sub>OUT</sub>		V <sub>DD</sub>	V
V <sub>ILSCK</sub>	SCK Input Voltage " L "	V <sub>DD</sub> =7.0V	0		0.2×V <sub>OUT</sub>	V
V <sub>IHCE</sub>	CE Input Voltage " H "		1.2		V <sub>DD</sub>	V
V <sub>ILCE</sub>	CE Input Voltage " L "		0		0.2	V
I <sub>IHSCK</sub>	SCK Input Current " H "	V <sub>DD</sub> =SCK=7.0V	-1		1	μA
I <sub>ILSCK</sub>	SCK Input Current " L "	V <sub>DD</sub> =7.0V, SCK=GND	-1		1	μA
R <sub>pu</sub>	CE Pull-up Resistance		2	4	10	MΩ
I <sub>CD</sub>	CD Pin Output Current	V <sub>DD</sub> =1.3V, V <sub>DS</sub> =0.5V	1	2		mA
I <sub>CTW</sub>	CTW Pin Output Current	V <sub>DD</sub> =1.3V, V <sub>DS</sub> =0.5V	1	2		mA
I <sub>RESET</sub>	RESET Pin Output Current	V <sub>DD</sub> =1.3V, V <sub>DS</sub> =0.5V	1	2		mA
I <sub>leak</sub>	RESET Pin Leakage Current	V <sub>DD</sub> =10.0V, CE=GND, V <sub>DS</sub> =12.0V	-1		1	μA
t <sub>sckw</sub>	SCK Input Pulse Width	V <sub>DD</sub> =7.0V, SCK=GND	500			ns
V <sub>start</sub>	Minimum Operating Voltage of Voltage Detector			0.9	1.3	V

●R5101G005A

T<sub>opt</sub>=25°C

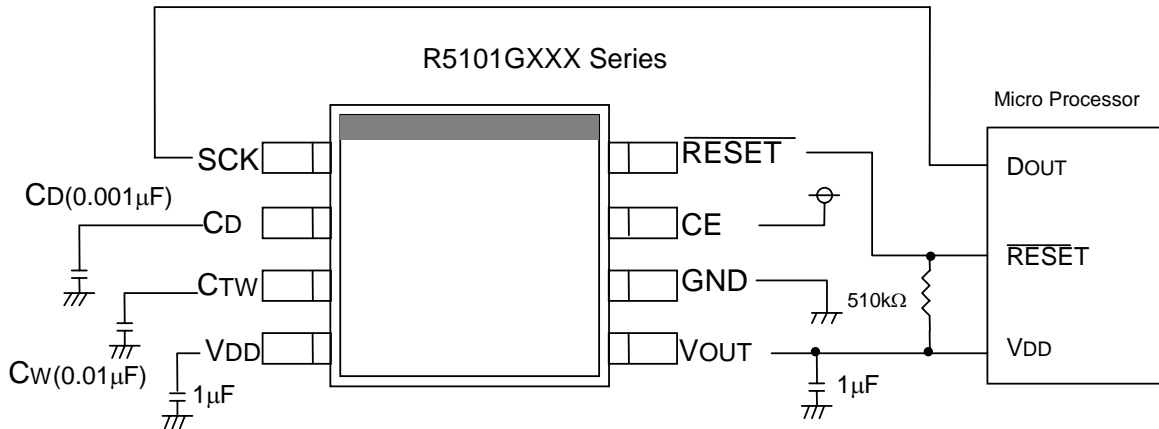
Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V <sub>DD</sub>	Operating Voltage				10	V
I <sub>ss-On</sub>	Supply Current (WDT active)	V <sub>DD</sub> =CE=4.8V		5	15	μA
I <sub>ss-Off</sub>	Supply Current (WDT inactive)	V <sub>DD</sub> =4.8V, CE=GND		6	18	μA
V <sub>OUT</sub>	Output Voltage	V <sub>DD</sub> =4.8V, I <sub>OUT</sub> =10mA	2.730	2.800	2.870	V
I <sub>OUT</sub>	Output Current	V <sub>DD</sub> =4.8V, I <sub>OUT</sub> =10mA	50			mA
V <sub>DIF</sub>	Dropout Voltage	I <sub>OUT</sub> =10mA	100	350	650	mV
ΔV <sub>OUT</sub> / ΔI <sub>OUT</sub>	Load Regulation	V <sub>DD</sub> =4.8V 1mA≤I <sub>OUT</sub> ≤50mA		50	100	mV
ΔV <sub>OUT</sub> / ΔV <sub>DD</sub>	Line Regulation	I <sub>OUT</sub> =10mA V <sub>OUT</sub> +0.5V≤V <sub>DD</sub> ≤10V		0.1	0.2	%/V
I <sub>lim</sub>	Current Limit (Short mode)	V <sub>OUT</sub> =0V	10	50	100	mA
ΔV <sub>OUT</sub> / ΔT <sub>opt</sub>	Output Voltage Temperature Coefficient	I <sub>OUT</sub> =10mA -40°C≤T <sub>opt</sub> ≤85°C		±100		ppm/ °C
-V <sub>DET</sub>	Detector Threshold		2.340	2.400	2.460	V
V <sub>HYS</sub>	Hysteresis Range		0.072	0.120	0.168	V
V <sub>DETMGN</sub>	Regulator Voltage Margin against Released Voltage	V <sub>OUT</sub> -((-V <sub>DET</sub> )+V <sub>HYS</sub> ), I <sub>OUT</sub> =10mA	0.02			V
Δ-V <sub>DET</sub> / ΔT <sub>opt</sub>	Detector Threshold Temperature Coefficient	-40°C≤T <sub>opt</sub> ≤85°C		±100		ppm/ °C
t <sub>pr</sub>	Reset Delay Time	V <sub>DD</sub> =4.8V, CD=0.001μF	7	14	21	ms
t <sub>wd</sub>	Watch Time of WDT	V <sub>DD</sub> =4.8V, CW=0.01μF	50	100	150	ms
t <sub>wr</sub>	Reset Hold Time of WDT	V <sub>DD</sub> =4.8V, CW=0.01μF	5	10	15	ms
V <sub>IHSCK</sub>	SCK Input Voltage " H "	V <sub>DD</sub> =4.8V	0.8×V <sub>OUT</sub>		V <sub>DD</sub>	V
V <sub>ILSCK</sub>	SCK Input Voltage " L "	V <sub>DD</sub> =4.8V	0		0.1×V <sub>OUT</sub>	V
V <sub>IHCE</sub>	CE Input Voltage " H "		1.2		V <sub>DD</sub>	V
V <sub>ILCE</sub>	CE Input Voltage " L "		0		0.2	V
I <sub>IHSCK</sub>	SCK Input Current " H "	V <sub>DD</sub> =SCK=4.8V	-1		1	μA
I <sub>ILSCK</sub>	SCK Input Current " L "	V <sub>DD</sub> =4.8V, SCK=GND	-1		1	μA
R <sub>pu</sub>	CE Pull-up Resistance			4		MΩ
I <sub>CD</sub>	CD Pin Output Current	V <sub>DD</sub> =1.3V, V <sub>DS</sub> =0.5V	1	2		mA
I <sub>CTW</sub>	CTW Pin Output Current	V <sub>DD</sub> =1.3V, V <sub>DS</sub> =0.5V	1	2		mA
I <sub>RESET</sub>	RESET Pin Output Current	V <sub>DD</sub> =1.3V, V <sub>DS</sub> =0.5V	1	2		mA
I <sub>leak</sub>	RESET Pin Leakage Current	V <sub>DD</sub> =10.0V, CE=GND, V <sub>DS</sub> =12.0V	-1		1	μA
t <sub>sckw</sub>	SCK Input Pulse Width	V <sub>DD</sub> =4.8V, SCK=GND	500			ns
V <sub>start</sub>	Minimum Operating Voltage of Voltage Detector			0.9	1.3	V



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## ■ TYPICAL APPLICATION

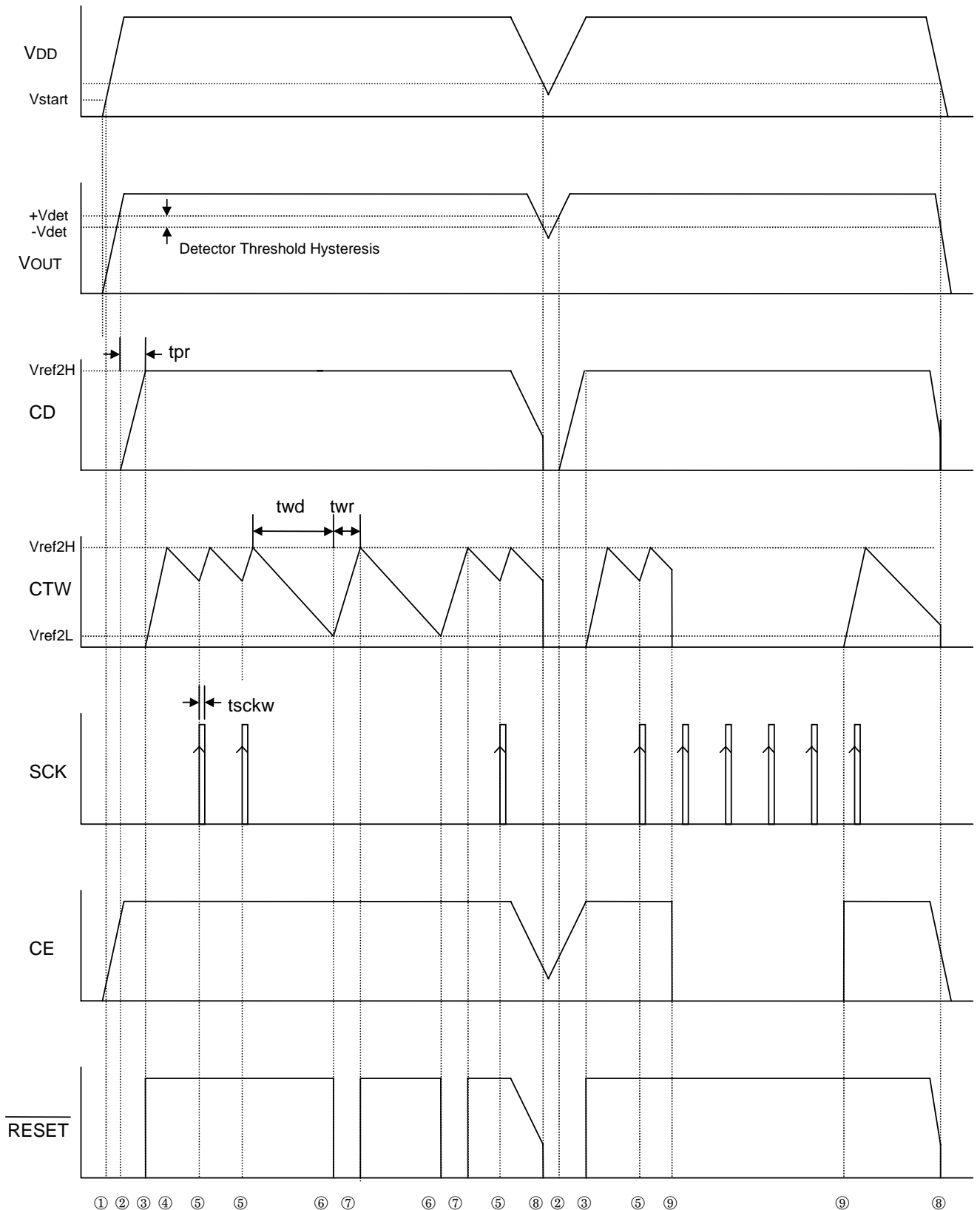


## ■ TECHNICAL NOTES

Use 0.01 $\mu$ F or more value of an external capacitor, CW for setting monitoring time of watchdog timer.

Use 1 or 2.2 $\mu$ F capacitor between VDD and GND, and between VOUT and GND and make its wiring as short as possible.

## OPERATION DIAGRAM



**RIGOH**

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## ■ OPERATION

① When  $V_{DD}$  is turned on and Input Voltage reaches  $V_{start}$  (nearly equal 0.8V), the output of  $\overline{RESET}$  pin becomes “L” level.

② An External Capacitor starts to be charged through the CD pin when an Output Voltage of the Voltage Regulator,  $V_{OUT}$ , crosses the Released Voltage,  $+V_{DET}$ , from Lower to Higher. The  $\overline{RESET}$  is kept “L” level until Voltage of the CD pin,  $V_{CD}$ , reaches to the  $V_{ref2H}$ , about 1.0V, and after that the  $\overline{RESET}$  becomes to “H” level.

\*  $t_{PR}$  : Time interval between the timing of starting edge of forcing voltage to  $V_{DD}$  pin and the timing of reverse the voltage level of  $\overline{RESET}$ .

$t_{PR}$  can be set by connecting an external capacitor to CD pin,  $t_{PR}$  can be calculated as shown below;

$t_{PR} \text{ (ms)} \approx 13000 \times CD \text{ (}\mu\text{F)}$ ; CD means a value of an external capacitor connected to CD pin.

③ When the voltage level of  $V_{CD}$  reaches to the  $V_{ref2H}$ , the external capacitor starts to be charged through the CTW pin and the watchdog timer begins to operate.

④ The operation mode for the external capacitor changes from charging mode to discharging mode through CTW pin when the voltage level of CTW pin,  $V_{CTW}$ , reaches to the  $V_{ref2H}$ .

⑤ While the CTW pin is on the discharging mode, if a clock pulse is entered (synchronous with a rising edge of the pulse), the operation mode of CTW pin changes from charging mode to discharging mode. And the external capacitor connected to CTW pin is charged until its voltage level reaches to  $V_{ref2H}$ .

⑥ While the CTW pin is on the discharging mode, if  $V_{CTW}$  level drops to  $V_{ref2L}$ , 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,  $t_{WD}$ , : Discharging Time of CTW pin level from  $V_{ref2H}$  to  $V_{ref2L}$

$t_{WD}$  can be set by connecting an external capacitor to CW pin,  $t_{WD}$  can be calculated as shown below;

$t_{WD} \text{ (ms)} \approx 10000 \times CW \text{ (}\mu\text{F)}$ ; CW means a value of an external capacitor connected to CW pin.

⑦ CTW pin is changed to charging mode from discharging mode when the Reset signal is generated.

\* Reset time of the watchdog timer,  $t_{WR}$ , : Time interval between Charging time of the CTW pin from  $V_{ref2L}$  to  $V_{ref2H}$ .  $t_{WR}$  can be calculated by the next equation as shown below;

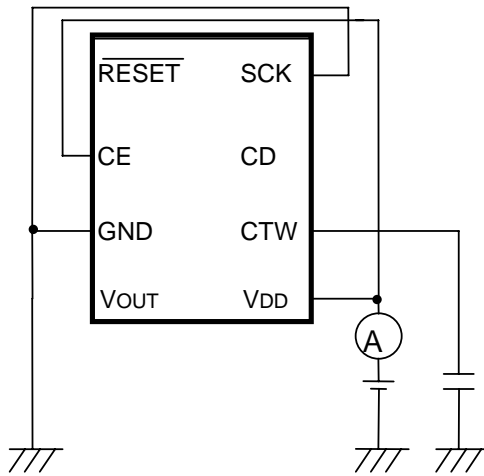
$t_{WR} \text{ (ms)} \approx t_{WD}/10$

⑧ The Output Voltage level of 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  $-V_{det}$ .

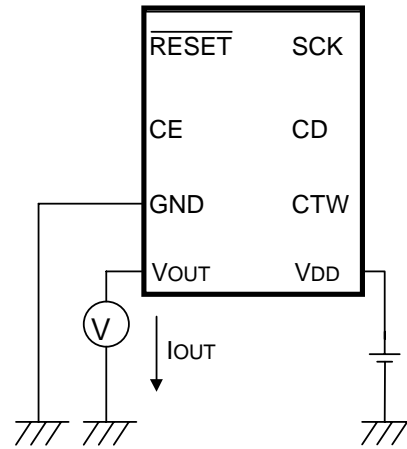
⑨ The watchdog timer will be halted when a Voltage level of CE pin becomes to “L”. In this case, only the watchdog timer is stopped and monitoring the output voltage is continued. After that, if the voltage level of CE pin becomes to “H”, CTW pin starts to be on charging mode.

## ■ TEST CIRCUITS

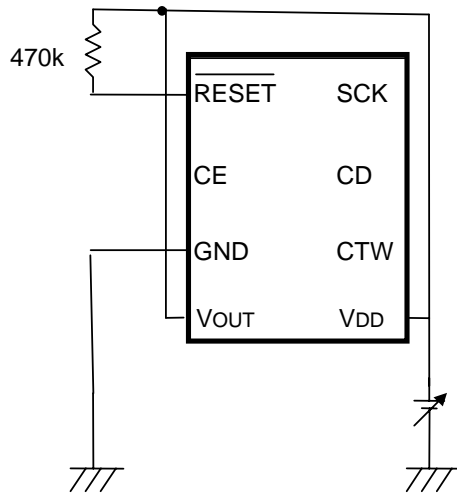
Test Circuit of Supply Current



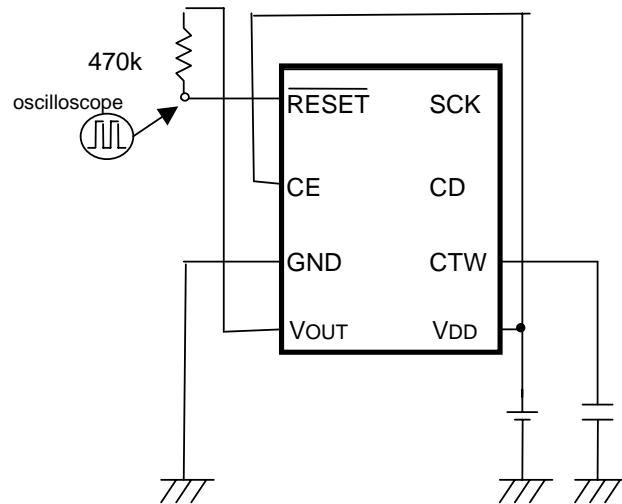
Test Circuit of Output Voltage



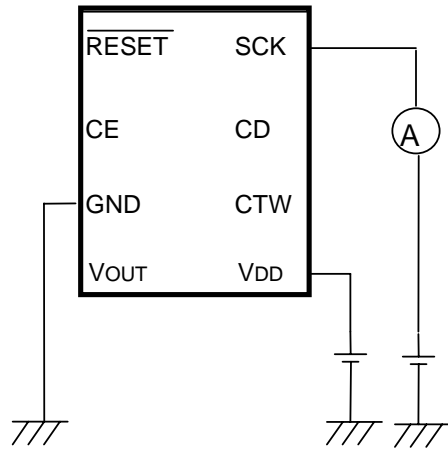
Test Circuit of Detector Threshold (VDET)



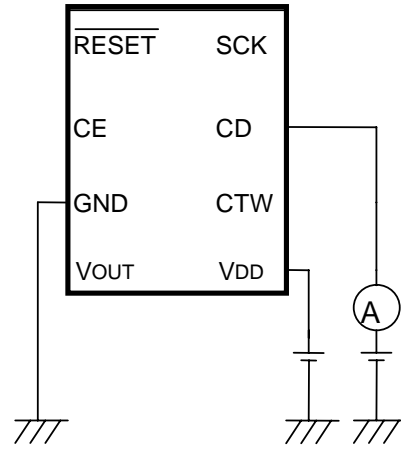
Test Circuit of Monitoring Time of WDT and RESET Time



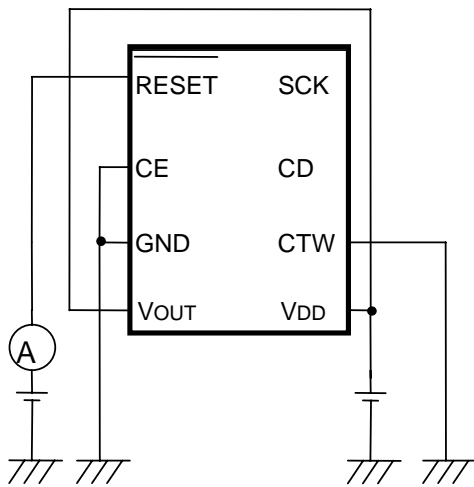
Test Circuit of SCK Input Current



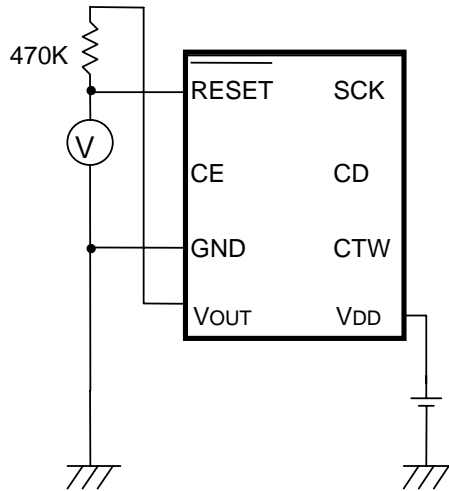
Test Circuit of Output Current



Test Circuit of RESET Output leakage Current

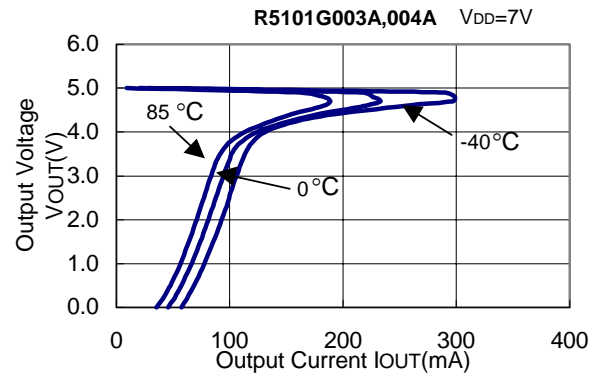
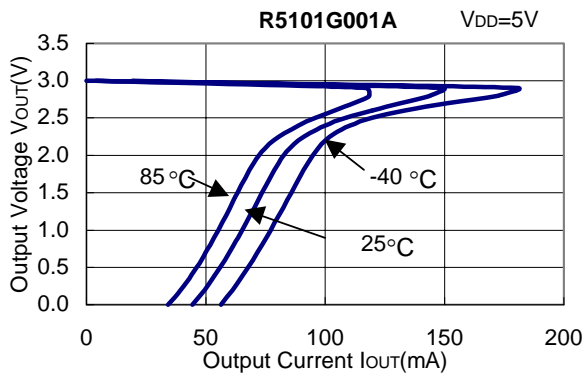


Test Circuit of Minimum Input Voltage for RESET Output

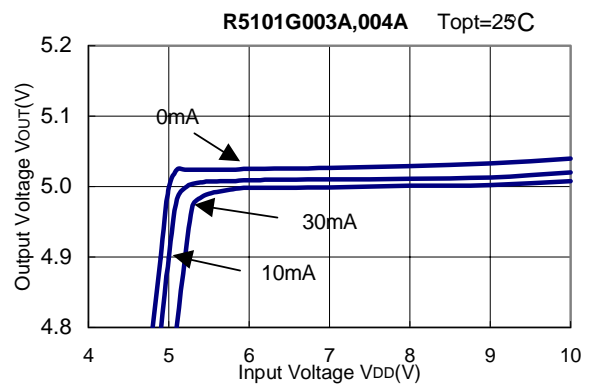
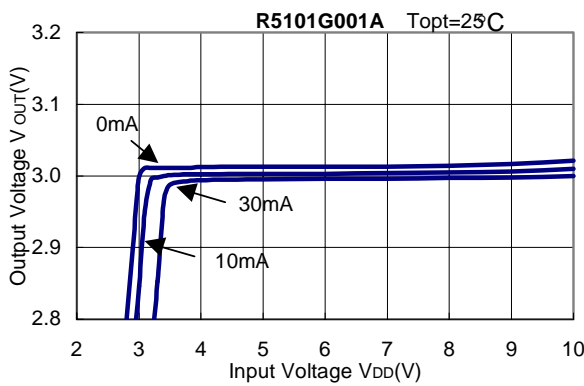


## ■ TYPICAL CHARACTERISTICS

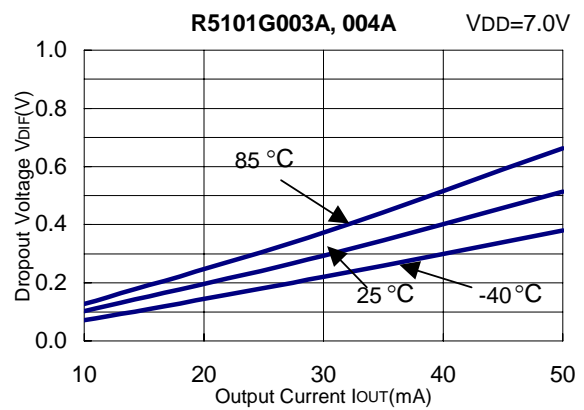
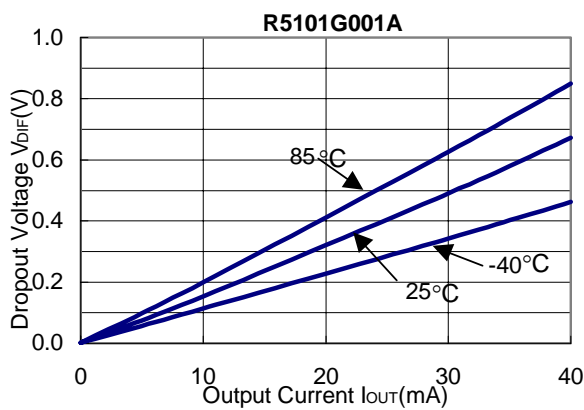
### 1) Output Voltage vs. Output Current



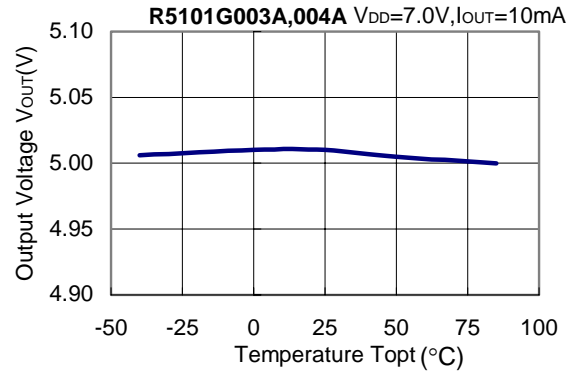
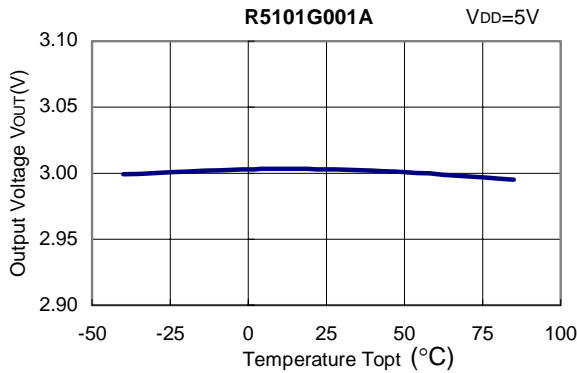
### 2) Output Voltage vs. Input Voltage



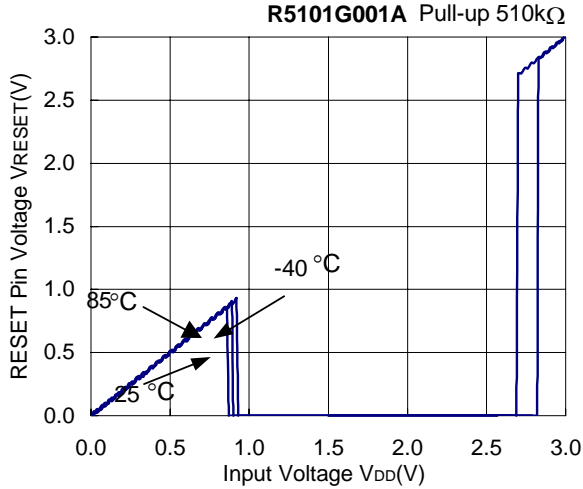
### 3) Dropout Voltage vs. Output Current



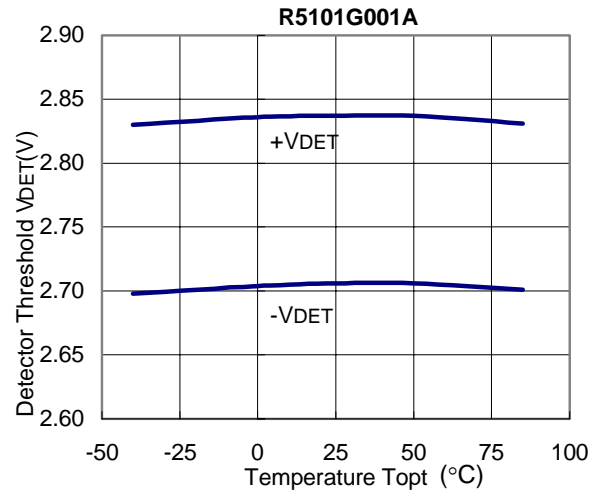
#### 4) Output Voltage vs. Temperature



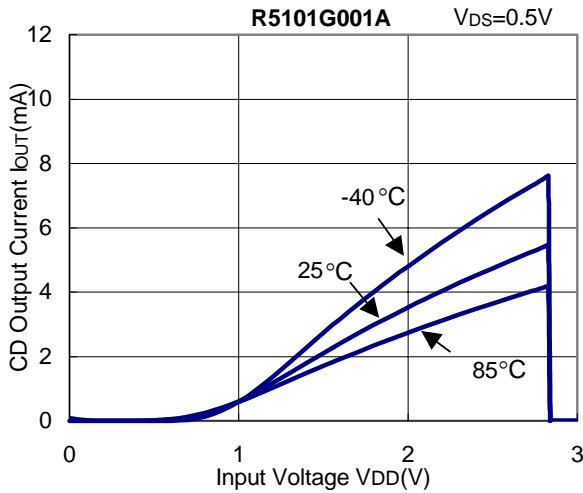
#### 5) RESET Pin Voltage vs. Input Voltage



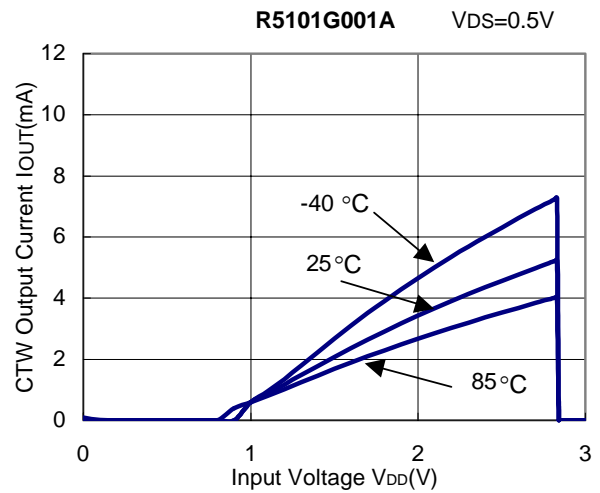
#### 6) Detector Threshold vs. Temperature



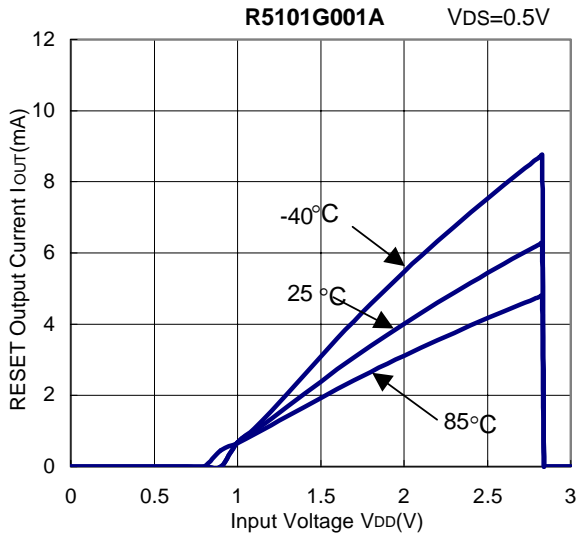
#### 7) CD Pin Output Current vs. Input Voltage



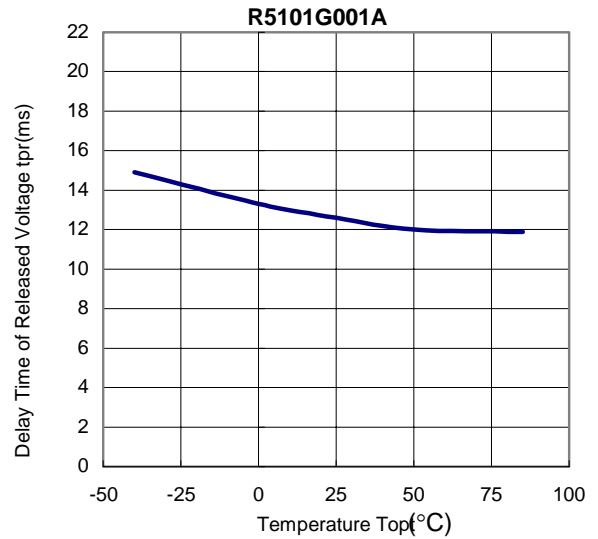
#### 8) CTW Pin Output Current vs. Input Voltage



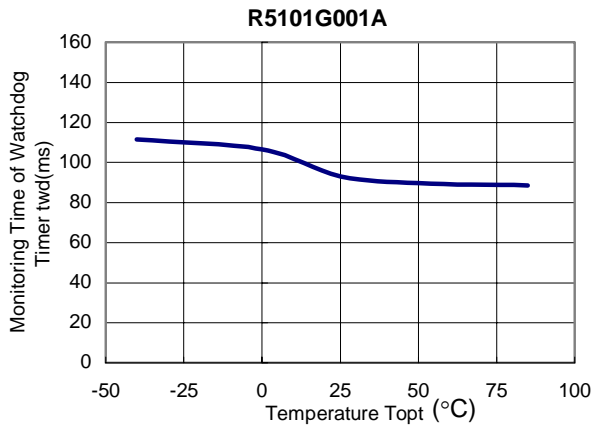
**9) RESET Pin Output Current vs. Input Voltage**



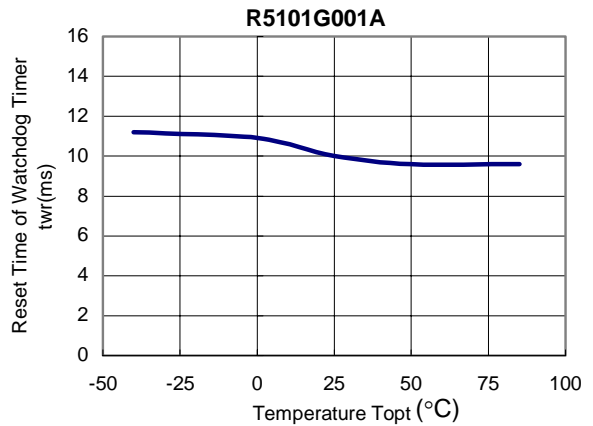
**10) Delay Time of Released Voltage vs. Temperature**



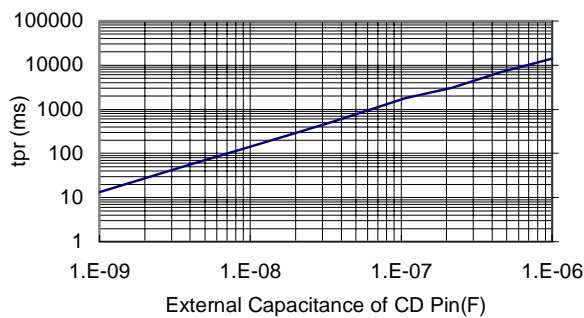
**11) Monitoring Time of Watchdog Timer vs. Temperature**



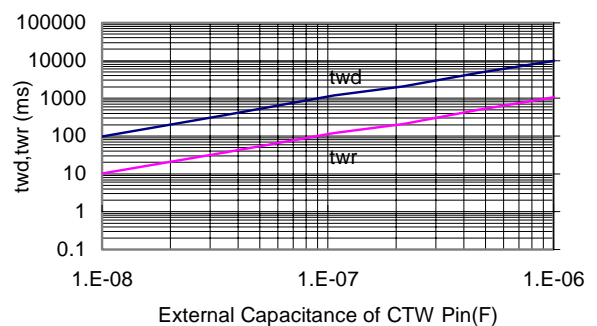
**12) Reset Time of Watchdog Timer vs. Temperature**



**13) tpr vs. External Capacitance of Cd Pin**

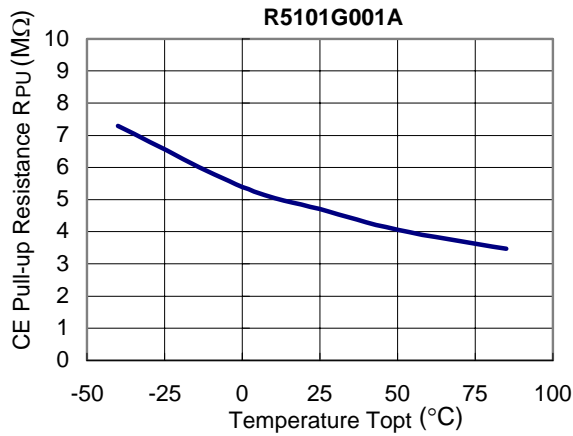


**14) twd, twr vs. External Capacitance of Ctw Pin**

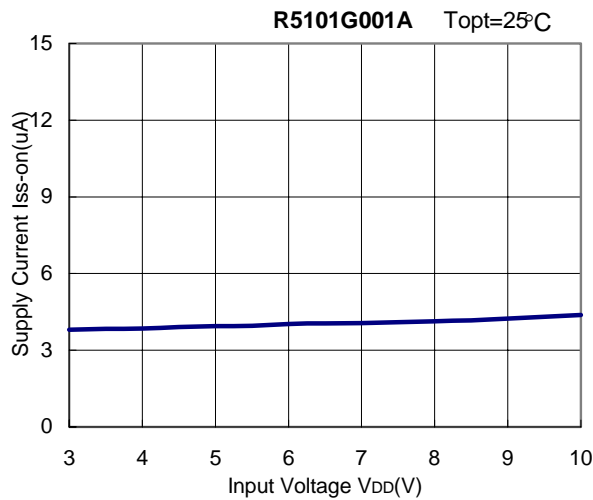




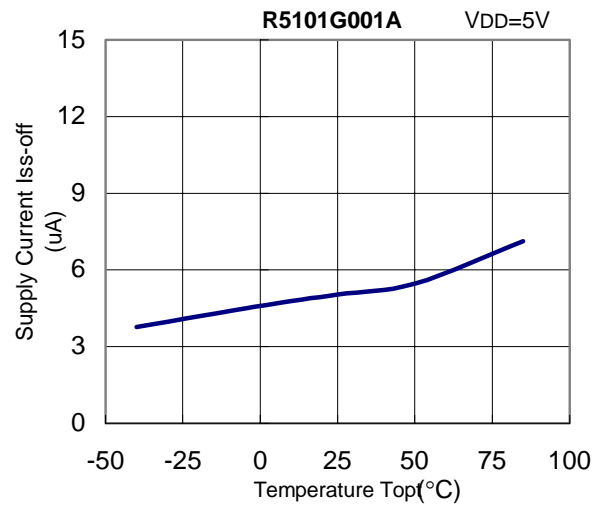
**15) CE Pull-up Resistance vs. Temperature**



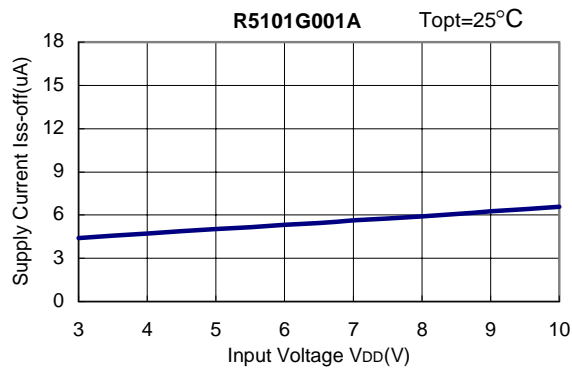
**16) Supply Current vs. Input Voltage (WDT ON)**



**17) Supply Current vs. Temperature (WDT ON)**



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



**19) Supply Current vs. Temperature (WDT OFF)**

