CA0022AN

WATCHDOG TIMER and RESET IC

■Device description

CA0022AN is watchdog timer reset IC.
It delivers a low current consumption and a small package. It can be used in a microcomputer to monitor power supply voltage and in system operation to prevent runaway operation.

■Functions and features

- Low current consumption: 14μA(Typ.)
- Operating temperature range: -40ºC～+85ºC(Automotive)
- Comparator with hysteresis
- RESET delay time can be set with the CT pin's external capacitance.
- Watchdog timer monitor time and reset time can be set with CTW pin's external capacitance.
- Watchdog timer operation can be set with the INH pin.
- Output type: N-channel open drain (RESET pin)
- Package: small, thin, bottom mounting
  (Plating Lead Package: 2.2mm×2.2mm×t:0.58mm 8pin)

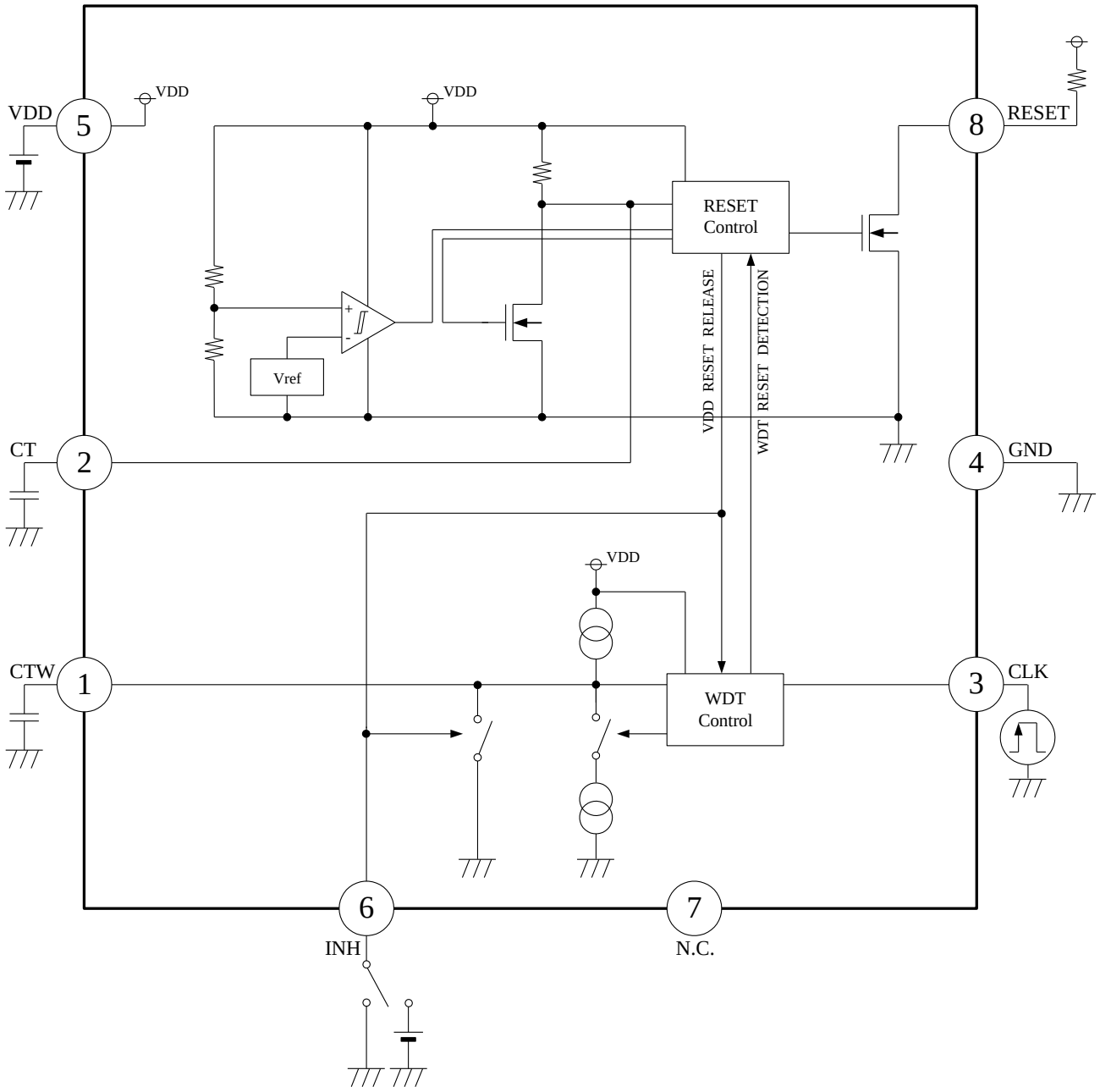
■ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Ratings	Unit
Power supply voltage	V_{DD}	-0.3～6.0	V
CT pin voltage	V_{CT}	-0.3～VDD+0.3	V
CTW pin voltage	V_{CTW}	-0.3～VDD+0.3	V
RESET pin voltage	V_{RESET}	-0.3～6.0	V
CLK pin voltage	V_{CLK}	-0.3～VDD+0.3	V
INH pin voltage	V_{INH}	-0.3～VDD+0.3	V
Power dissipation	Pd	90	mW
Operating ambient temperature	Ta	-40～+85	ºC
Junction temperature	Tj	-40～+125	ºC
Storage temperature	Tstg	-40～+125	ºC

■RECOMMENDED OPERATING RANGES（Ta = -40℃～+85℃）

Item	Symbol	Ratings	Unit
Power supply voltage	V_{DD}	1.5～6.0	V

■BLOCK DIAGRAM



■ELECTRICAL CHARACTERISTICS

Unless otherwise specified, Ta = -40ºC～+85ºC, V_{DD}=3.3V. TYP values are at Ta = +25ºC. *1

Item	Symbol	Condition	MIN	TYP	MAX	Unit
Consumption current	I_{DD}	During WDT operation	-	14.0	20.0	μA
Detection voltage	V_{DET}	Ta=25ºC	2.765	2.875	2.985	V
		-40ºC ≤ Ta ≤ +85ºC	2.740	2.875	3.010	
Hysteresis width	V_{hys}	Ta=25ºC	130	145	160	mV
		-40ºC ≤ Ta ≤ +85ºC	125	145	165	mV
RESET output current	I_{OL}	V_{DD}=1.5V, V_{DS}=0.5V	0.7	2.0	-	mA
RESET output leak current	I_{OH}	V_{DD}=3.3V, V_{DS}=3.3V	-	0.0	1.0	uA
RESET delay time *2	T_{PLH}	L→H CT=0.001μF	3.9	6.9	10.1	ms
Delay pin circuit resistance	R_{RST}	V_{CT}=GND	5.8	10.0	14.5	MΩ
Delay pin threshold voltage	V_{CTH}	-	VDD×0.3	VDD×0.5	VDD×0.6	V
Delay pin output current	I_{CT}	V_{DD}=1.5V,V_{CT}=0.5V	150	330	-	uA
Minimum operating supply voltage	V_{OPL}	V_{DS}=0.3V, $R_{pull-up}$=10kΩ	-	-	1.5	V
WDT monitor time *3	T_{WH}	C_{CTW}=0.01μF	7.0	11.1	20.0	ms
WDT reset time *4	T_{WL}	C_{CTW}=0.01μF	2.4	3.7	7.0	ms
CLK input pulse width	T_{WCLK}	-	500	-	-	ns
CLK high level voltage	V_{CLKH}	-	VDD×0.8	-	VDD	V
CLK low level voltage	V_{CLKL}	-	0	-	VDD×0.3	V
INH high level voltage	V_{INHH}	-	VDD×0.8	-	VDD	V
INH low level voltage	V_{INHL}	-	0	-	VDD×0.3	V
CTW charge current	I_{CTWC}	V_{CTW}=0.15V	0.25	0.45	0.75	uA
CTW discharge current	I_{CTWO}	V_{CTW}=0.85V	0.75	1.35	2.00	uA

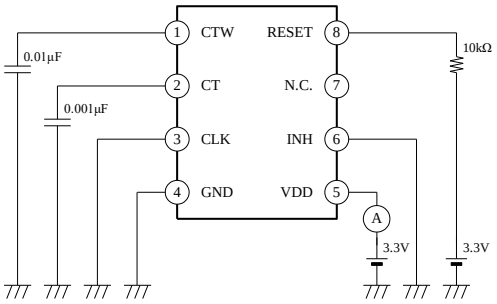
*1 High and low temperature limits are guaranteed by design, production testing performed at +25ºC only.

*2 T_{PLH} can be varied by the CT pin capacitance value.
$T_{PLH}(s) \fallingdotseq 0.69 \times R_{RST}(M\Omega) \times C_{CT}(\mu F)$

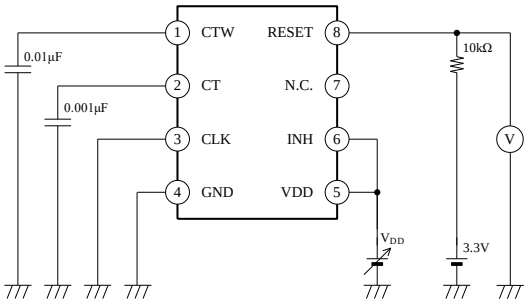
*3 T_{WH} can be varied by the CTW pin capacitance value.
$T_{WH}(s) \fallingdotseq 0.5 \times C_{CTW}(\mu F) / I_{CTWC}(\mu A)$

*4 T_{WL} can be varied by the CTW pin capacitance value.
$T_{WL}(s) \fallingdotseq 0.5 \times C_{CTW}(\mu F) / I_{CTWO}(\mu A)$

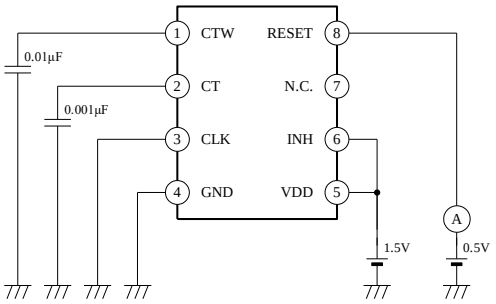
■MEASUREMENT CIRCUIT DIAGRAM



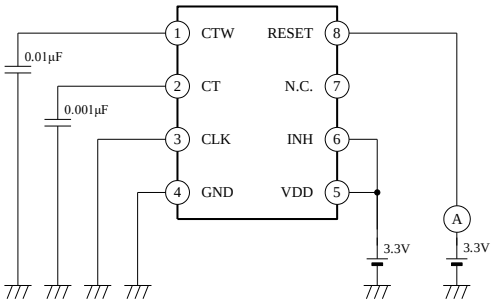
Consumption current



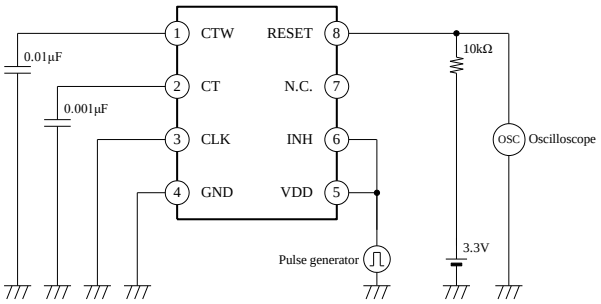
Detection voltage ／ Hysteresis width



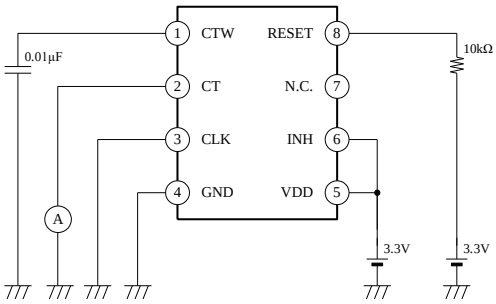
RESET output current



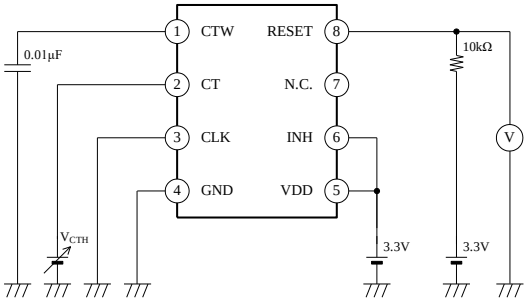
RESET output leak current



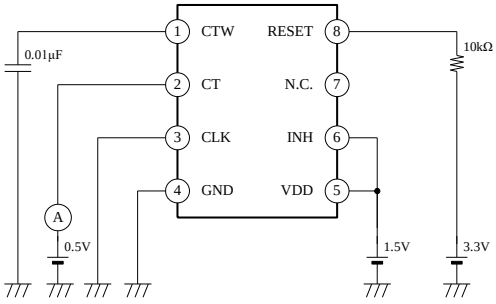
RESET delay time



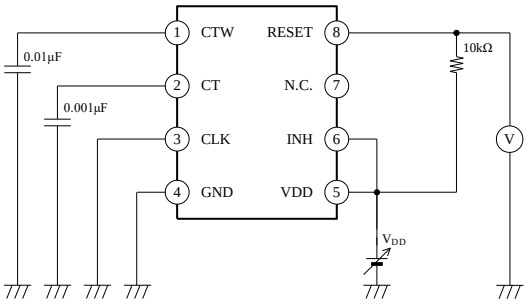
Delay pin circuit resistance



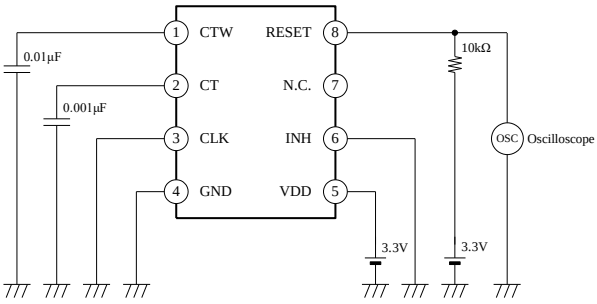
Delay pin threshold voltage



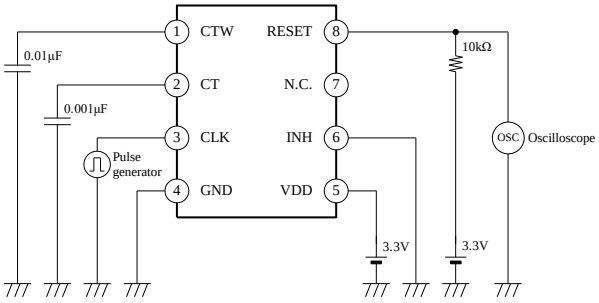
Delay pin output current



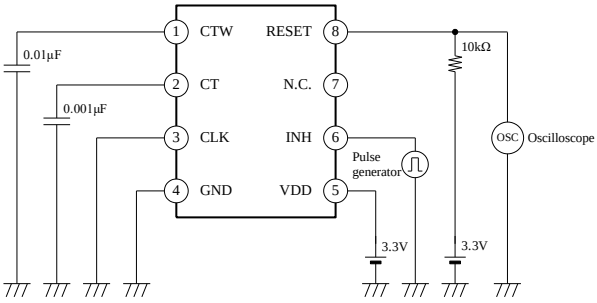
Minimum operating supply voltage



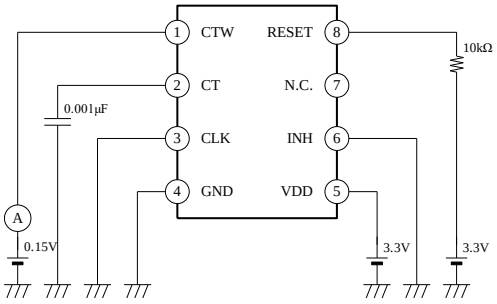
WDT monitor time ／ WDT reset time



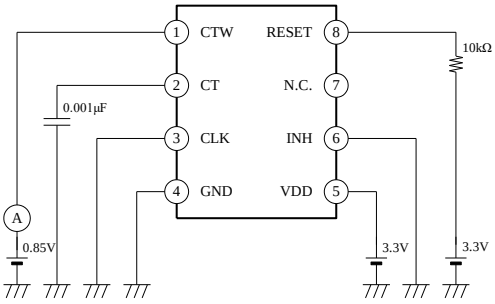
CLK input pulse width ／ CLK high level voltage ／ CLK low level voltage



INH high level voltage ／ INH low level voltage



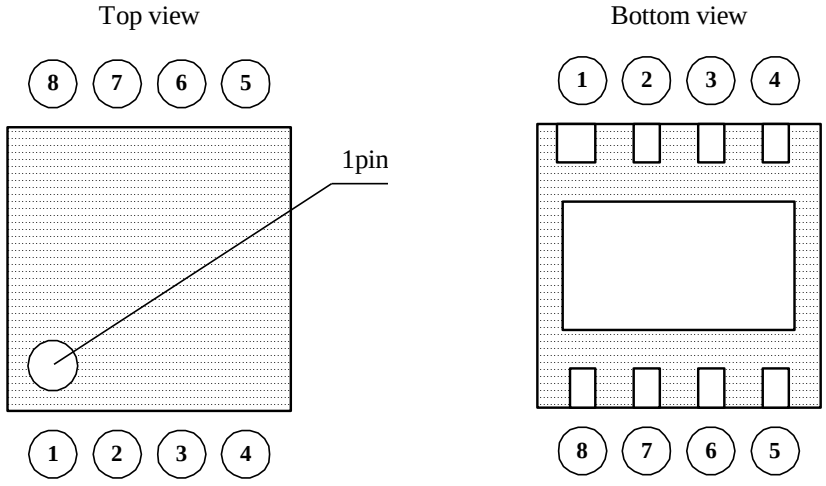
CTW charge current



CTW discharge current

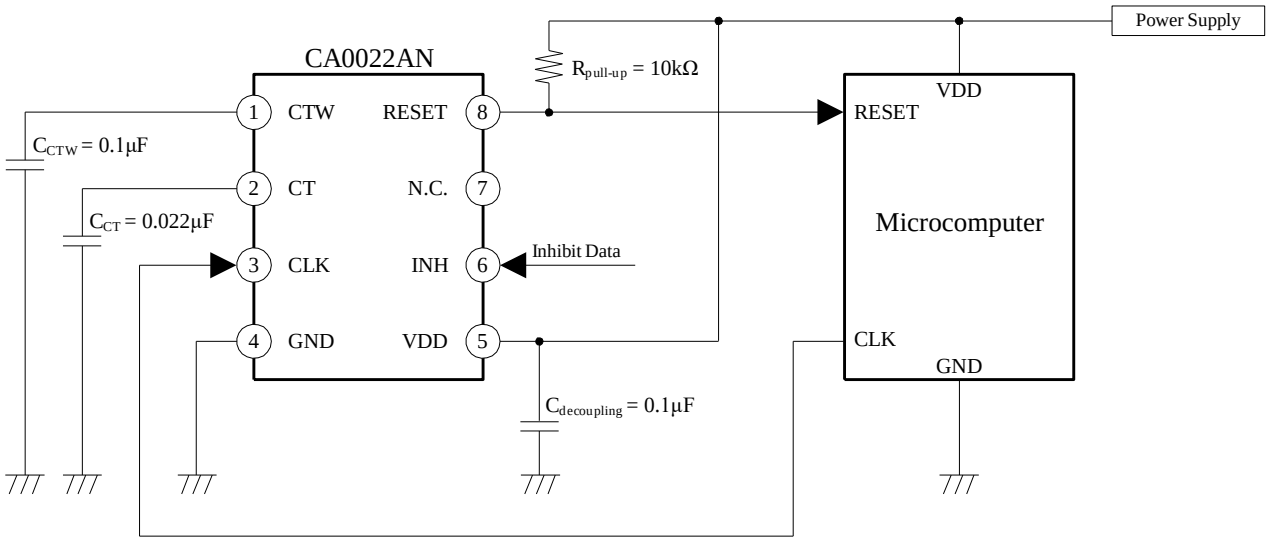
■TERMINAL FUNCTIONS

Pin No.	Symbol	Terminal function
1	CTW	WDT time setting capacitor connection terminal
2	CT	RESET delay time setting capacitor connection terminal
3	CLK	Clock input terminal (Rising edge detection)
4	GND	Ground terminal
5	VDD	Power supply terminal
6	INH	WDT on/off terminal (INH=H/L : WDT=off/on)
7	N.C.	Non connection terminal
8	RESET	RESET output terminal(N-channel open drain)



Open the electric potential of the die pad on the back side of the package or connect the die pad to the GND.
When the die pad is connected to the GND, do not use the die pad as the electrode unless shorting with 4 pin.

■BASIC CIRCUIT EXAMPLE



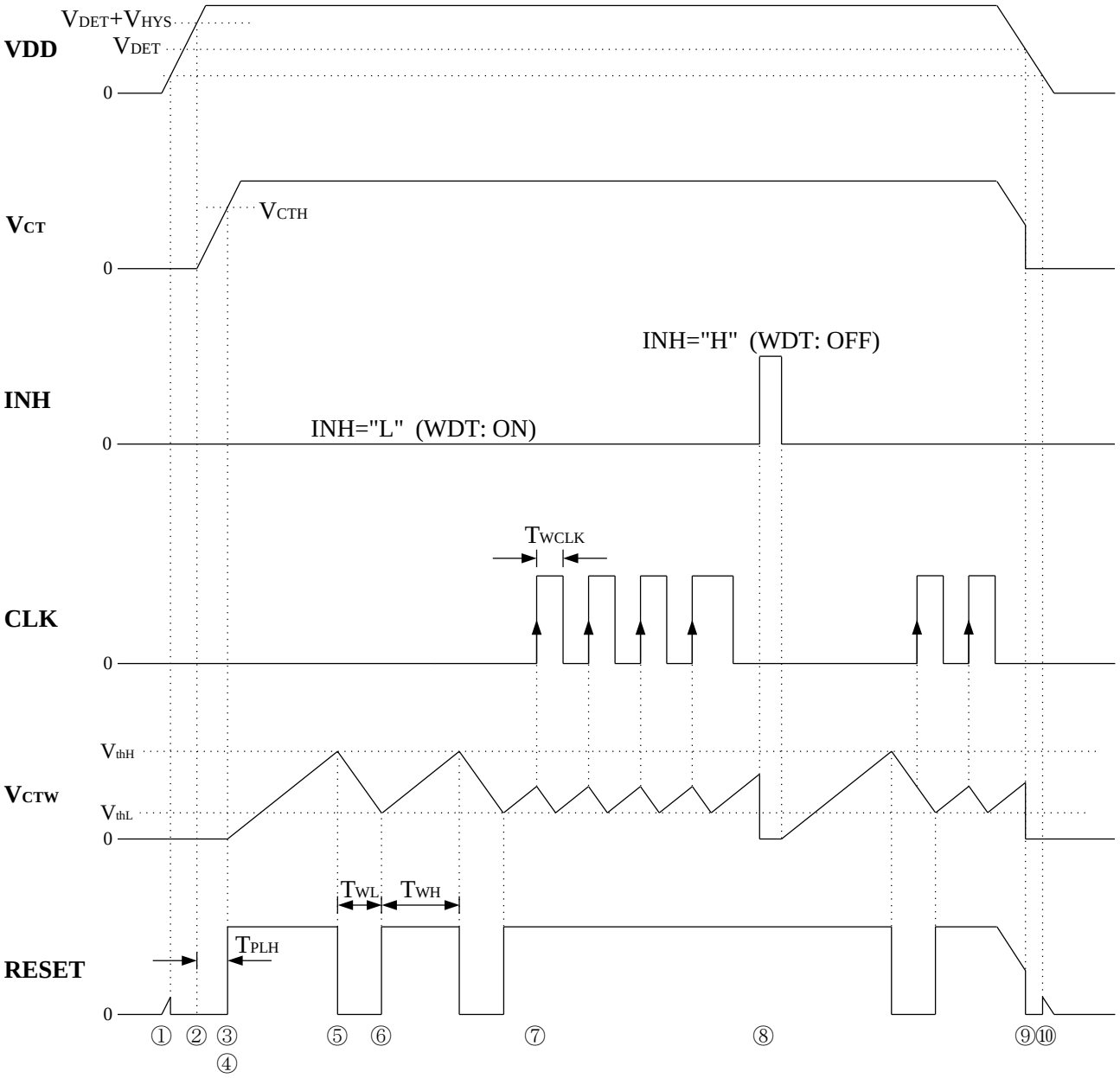
※Connection and constant of CT pin external capacitor and CTW pin external capacitor and RESET pin external resistor and Decoupling capacitor in the above figure does not guarantee the operation. Please select the constant perform enough evaluation including the temperature characteristics.

Capacitance recommended value is as follows.

CT pin external capacitor: C_{CT} = 470pF to 3.3μF

CTW pin external capacitor: C_{CTW} = 0.001μF to 10μF

■TIMING CHART



■OPERATION EXPLANATION

①. The RESET pin voltage switches to low voltage when the power supply voltage V_{DD} rises to about 0.8V.

②. The external capacitor connected to the CT pin begins to charge when V_{DD} rises above the reset release voltage $V_{DET}+V_{HYS}$.

③. The RESET switches to high voltage (release) from low voltage (detection) when the CT pin voltage V_{CT} reaches the delay pin threshold voltage V_{CTH}. RESET delay time T_{PLH} is given by the following equation:

$T_{PLH}(s) \fallingdotseq 0.69 \times R_{RST}(M\Omega) \times C_{CT}(\mu F)$

$R_{RST}(M\Omega)$ denotes the IC's built-in resistance and is designed to be 10MΩ(Typ.). $C_{CT}(\mu F)$ denotes the external capacitor connected to the CT pin and can be set optionally.

④. The external capacitor connected to the CTW pin begins to charge when the RESET switches to release from detection, the watchdog timer operates.

⑤. The CTW pin state switches from charge to discharge when the CTW pin voltage VCTW reaches the V_{thH}, the RESET switches to low voltage from high voltage. The watchdog timer monitor time T_{WH} is given by the following equation:

$T_{WH}(s) \fallingdotseq 0.5 \times C_{CTW}(\mu F) / I_{CTWC}(\mu A)$

$I_{CTWC}(\mu A)$ denotes CTW charge current and is designed to be 0.45μA(Typ.). $C_{CTW}(\mu F)$ denotes the external capacitor connected to the CTW pin and can be set optionally.

⑥. The CTW pin state switches from discharge to charge when the CTW pin voltage V_{CTW} reaches the V_{thL}, the RESET switches to high voltage from low voltage. The watchdog timer reset time T_{WL} is given by the following equation:

$T_{WL}(s) \fallingdotseq 0.5 \times C_{CTW}(\mu F) / I_{CTWO}(\mu A)$

$I_{CTWO}(\mu A)$ denotes CTW discharge current and is designed to be 1.35μA(Typ.). $C_{CTW}(\mu F)$ denotes the external capacitor connected to the CTW pin and can be set optionally.

⑦. When a pulse is input to the CLK pin while the CTW pin is charging, the CTW pin state switches from charge to discharge. Once the CTW pin discharge and V_{CTW} reaches V_{thL}, the CTW pin will charge again. The CLK pin pick up only the rising edge. Pick up operation is unaffected by duty of a pulse. The CTW pin state does not switch to discharge while V_{CTW} is V_{thL} or below, if a pulse is input to CLK.

⑧. When the INH pin switches to high, watchdog timer operation is forced off by discharging forcibly the CTW pin state. Only watchdog timer function is turned off, and detection function for power supply voltage is performed normally. While the INH pin is high, these functions stay are performed.

⑨. RESET switches to low from high when V_{DD} falls below the reset detection voltage V_{DET}.

⑩. RESET signal stays low until V_{DD} falls about 0.8V.

※WDT monitor time

Only first WDT monitor time after reset release by rising voltage, and first WDT monitor time after watchdog timer switches to ON from OFF by input to the INH pin, is given by the following equation:

$T_{WH1}(s) \fallingdotseq 0.75 \times C_{CTW}(\mu F) / I_{CTWC}(\mu A)$

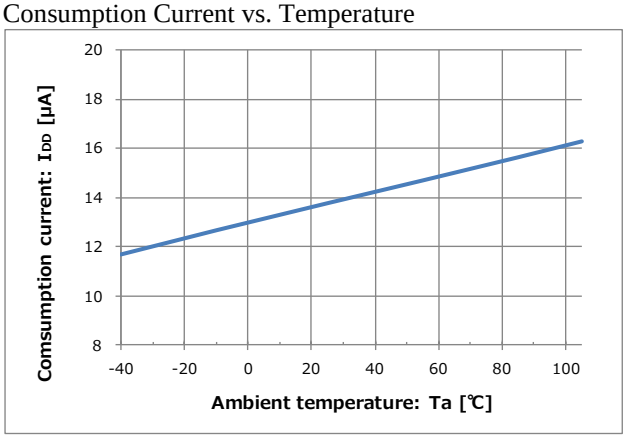
When capacitance of CTW pin external capacitor is used bigger, the capacitor takes longer to discharge by INH function. Note that the WDT monitor time may be shorter than the above equation when the capacitor is not discharged enough.

※CLK pin and INH pin

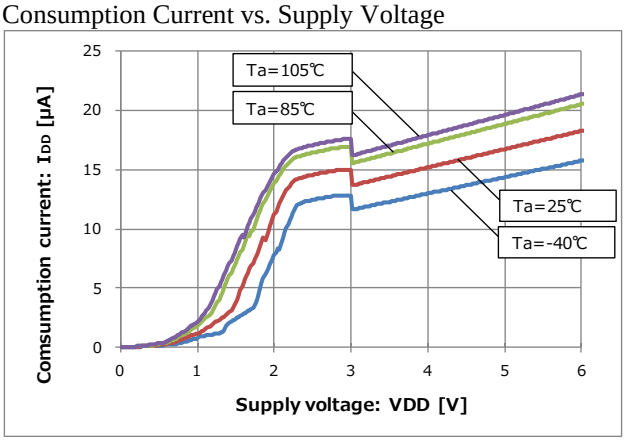
CLK pin and INH pin should not left open because of connecting CMOS gates. These pins should be either pulled up or down.

■CHARACTERISTIC DATA(REFERENCE)

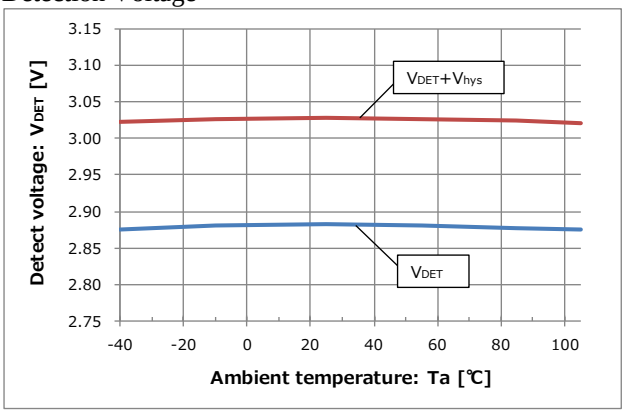
Consumption Current vs. Temperature



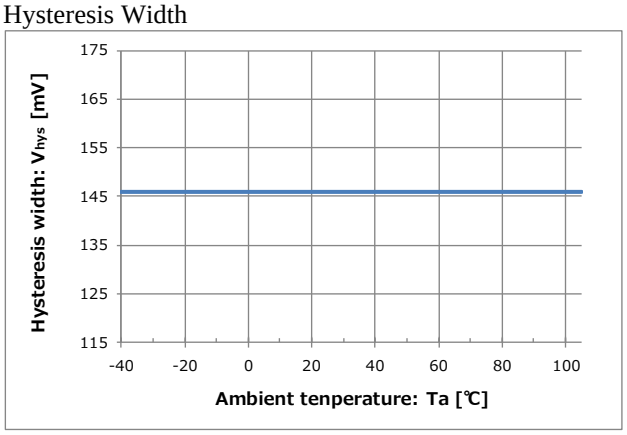
Consumption Current vs. Supply Voltage



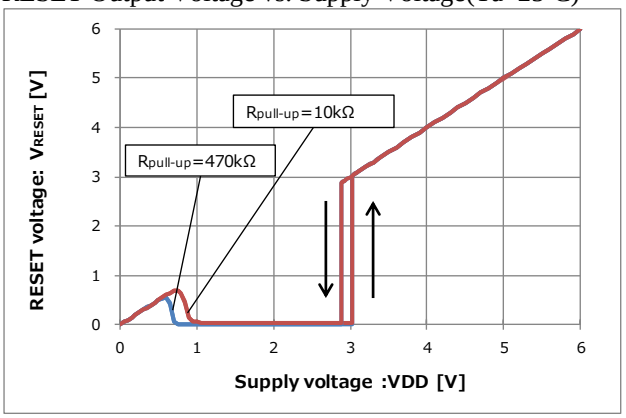
Detection Voltage



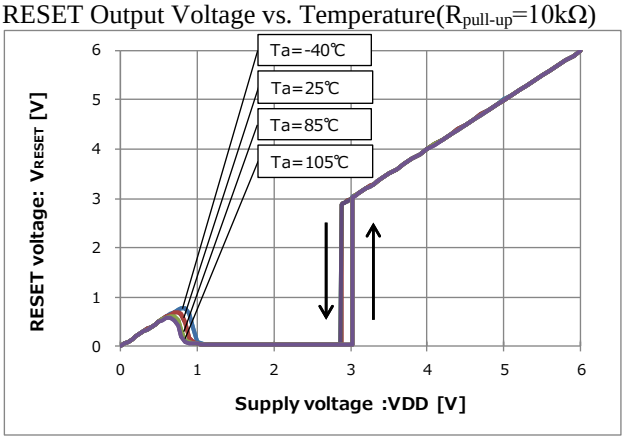
Hysteresis Width



RESET Output Voltage vs. Supply Voltage(Ta=25ºC)

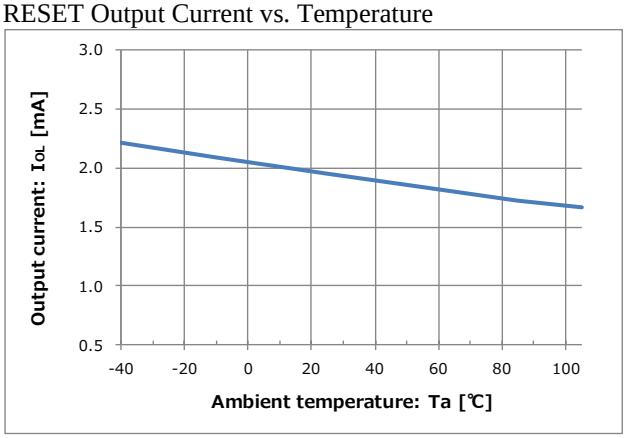


RESET Output Voltage vs. Temperature($R_{pull-up}$=10kΩ)

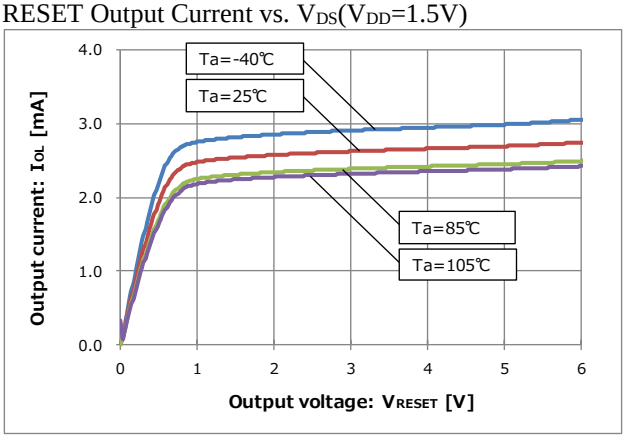


■CHARACTERISTIC DATA(REFERENCE)

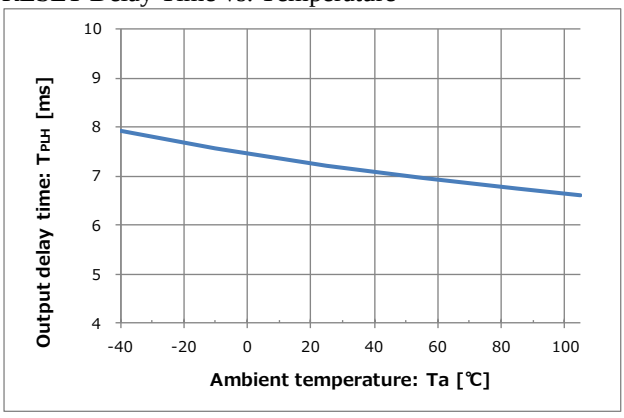
RESET Output Current vs. Temperature



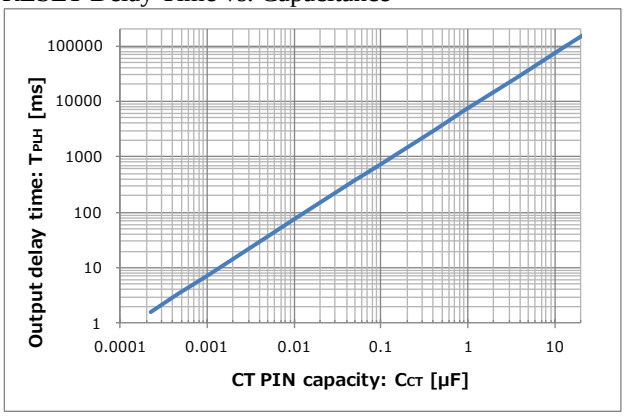
RESET Output Current vs. V_{DS}(V_{DD}=1.5V)



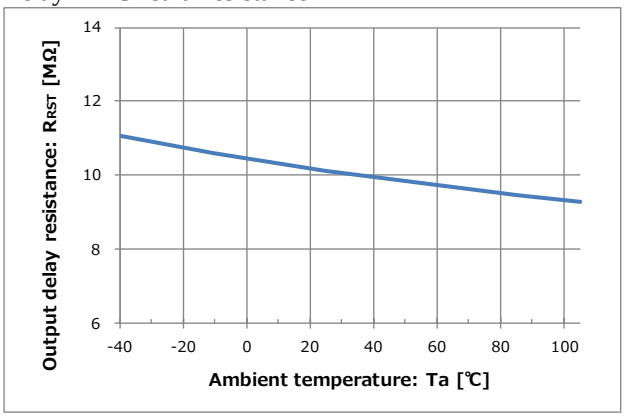
RESET Delay Time vs. Temperature



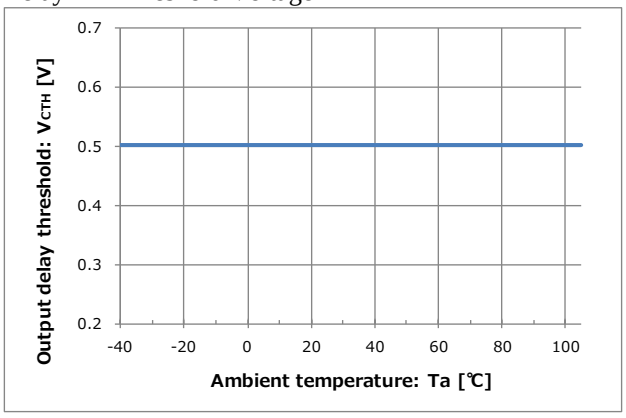
RESET Delay Time vs. Capacitance



Delay Pin Circuit Resistance

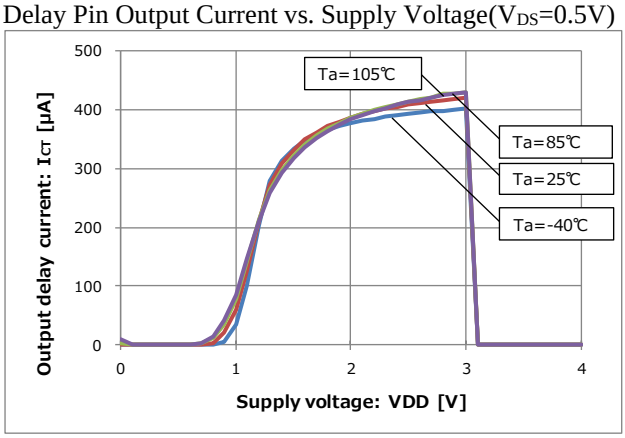


Delay Pin Threshold Voltage

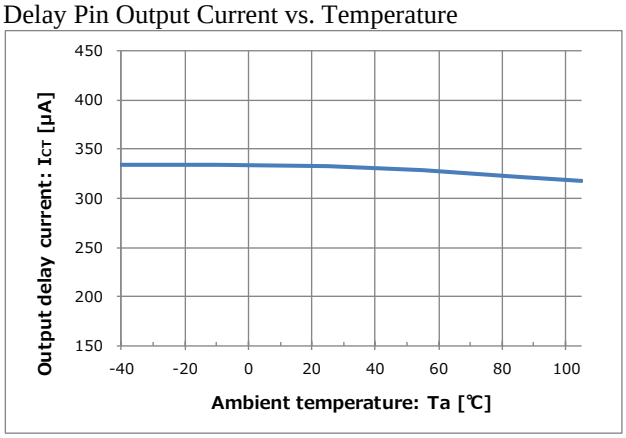


■CHARACTERISTIC DATA(REFERENCE)

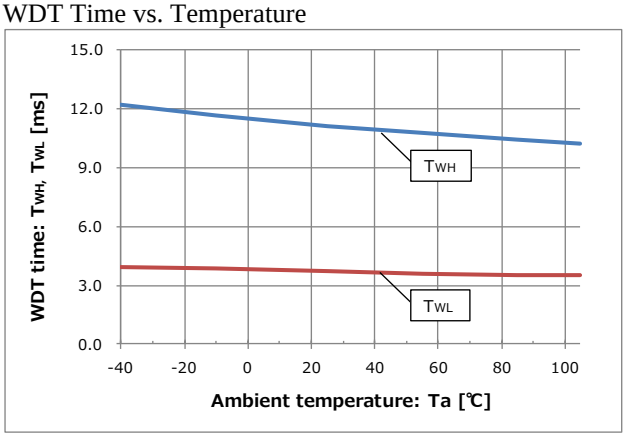
Delay Pin Output Current vs. Supply Voltage(V_{DS}=0.5V)



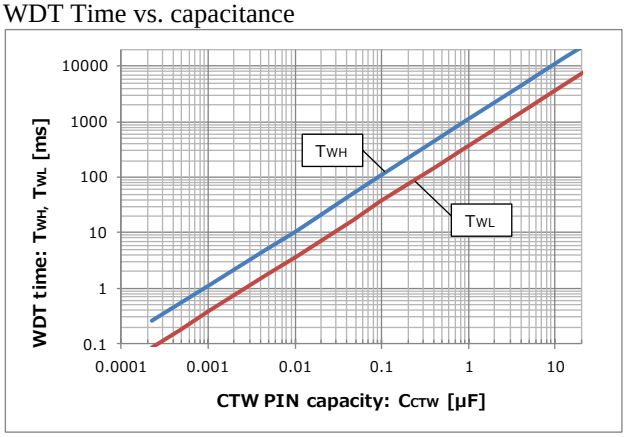
Delay Pin Output Current vs. Temperature



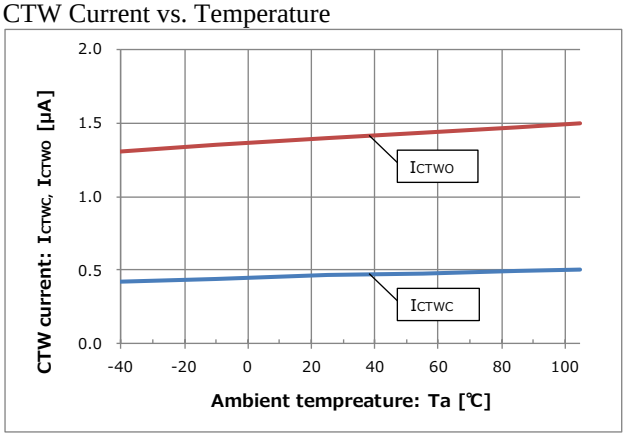
WDT Time vs. Temperature



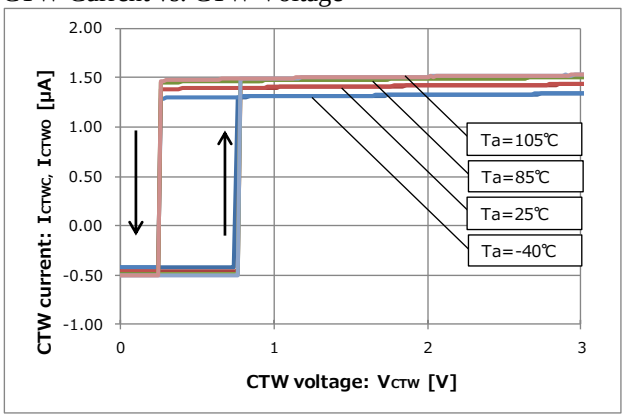
WDT Time vs. capacitance



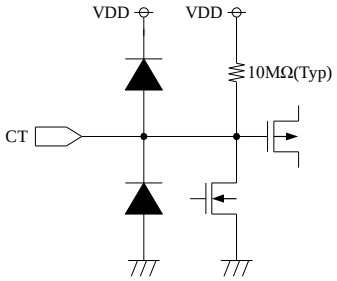
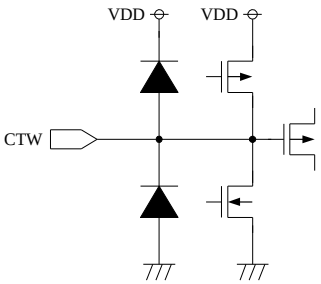
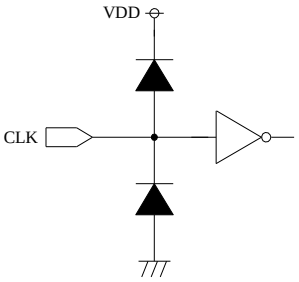
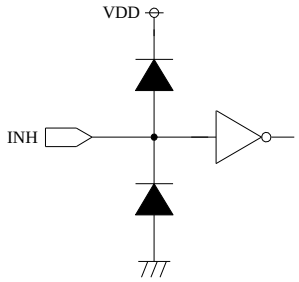
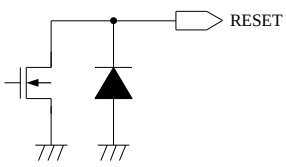
CTW Current vs. Temperature



CTW Current vs. CTW Voltage

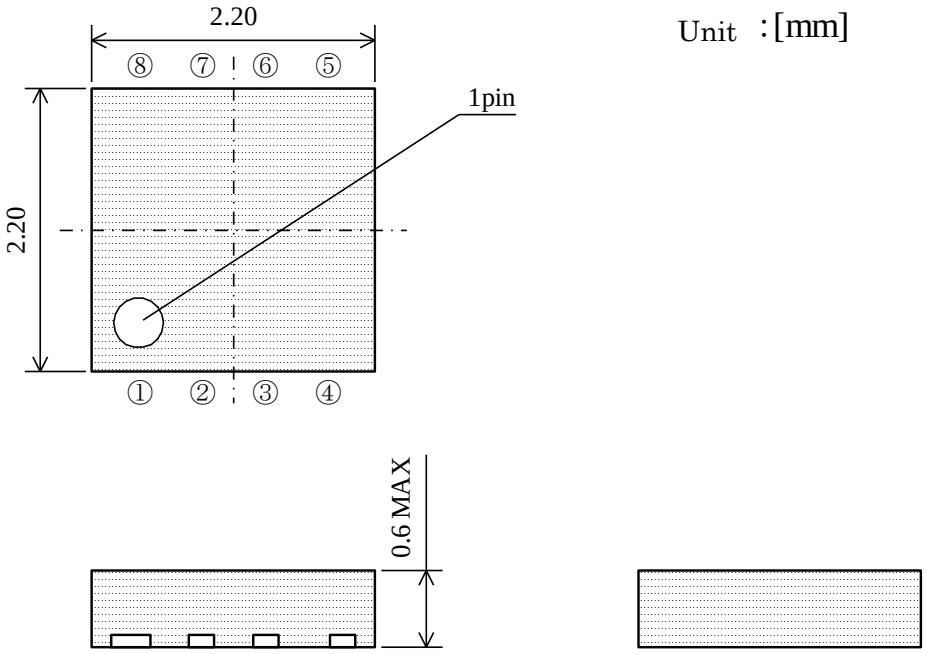


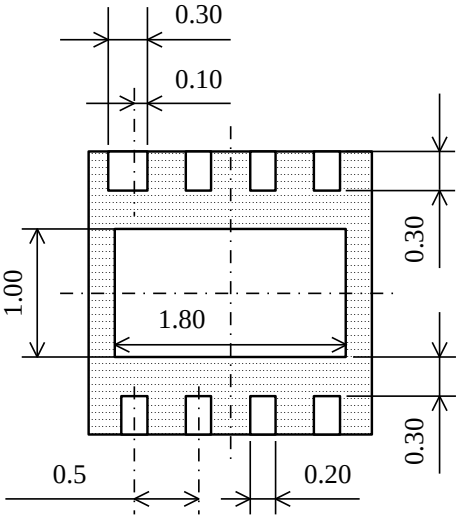
■EQUIVALENT CIRCUIT OF INPUT AND OUTPUT TERMINAL

Symbol	Equivalent circuit
VDD	
GND	
CT	
CTW	
CLK	
INH	
RESET	

■EXTERNAL DIMENSIONS

Unit :[mm]





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