To all our customers

Regarding the change of names mentioned in the document, such as Mitsubishi Electric and Mitsubishi XX, to Renesas Technology Corp.

The semiconductor operations of Hitachi and Mitsubishi Electric were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Mitsubishi Electric, Mitsubishi Electric Corporation, Mitsubishi Semiconductors, and other Mitsubishi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Note : Mitsubishi Electric will continue the business operations of high frequency & optical devices and power devices.

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

M5295AL/P/FP

WATCHDOG TIMER

DESCRIPTION

M5295A is a semiconductor integrated circuit which is designed for System Reset to detect +5V power supply.
This IC keeps the operation microcomputer watching.
When the system is abnormal,it generates Reset output until the system returns to normal states of the System.
It is possible to vary the two detective voltage by connecting the resistor,so it is suitable to high quality and high performance system.

FEATURES

•Watch Dog Timer
•Power on Reset Timer
•Low circuit current 0.8mA(Typ,Vcc=5V)
•Wide Range of power supply

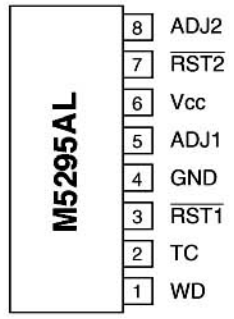
APPLICATION

Microcomputer Systems

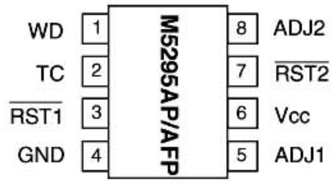
RECOMMENDED OPERATING CONDITIONS

Supply voltage..4V to 15V
Rated supply voltage..5V

PIN CONFIGURATION (TOP VIEW)

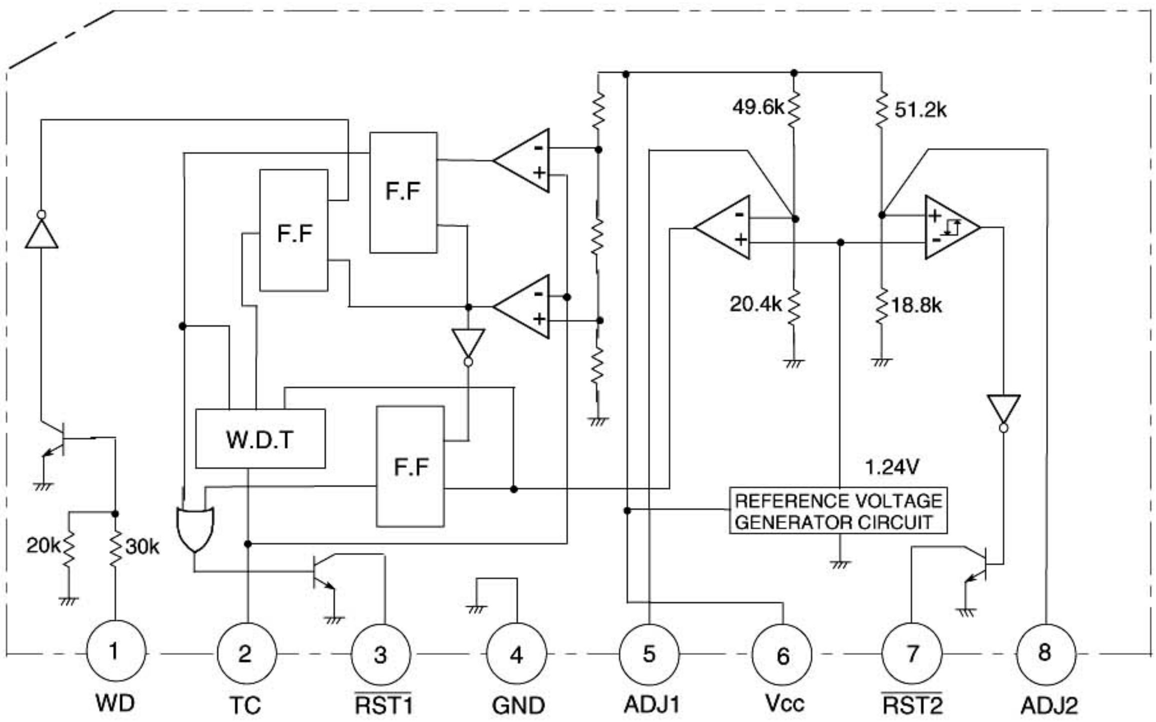


Outline 8P5(AL)



Outline 8P4(AP)
8P2S-A(AFP)

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (Ta=25°C,unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{cc}	Supply voltage		15	V
V_{IN}	Input voltage		-10 to +10	V
V_{OUT}	Output voltage		15	V
I_{OUT}	Output current		10	mA
Pd	Power dissipation		800(SIP)/625(DIP)/440(FP)	mW
K_{θ}	Thermal derating	Ta≥25°C	8(SIP)/6.25(DIP)/4.4(FP)	mW/°C
Topr	Operating temperature		-20 to +75	°C
Tstg	Storage temperature		-55 to +125	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C,Vcc=5V,unless otherwise noted)

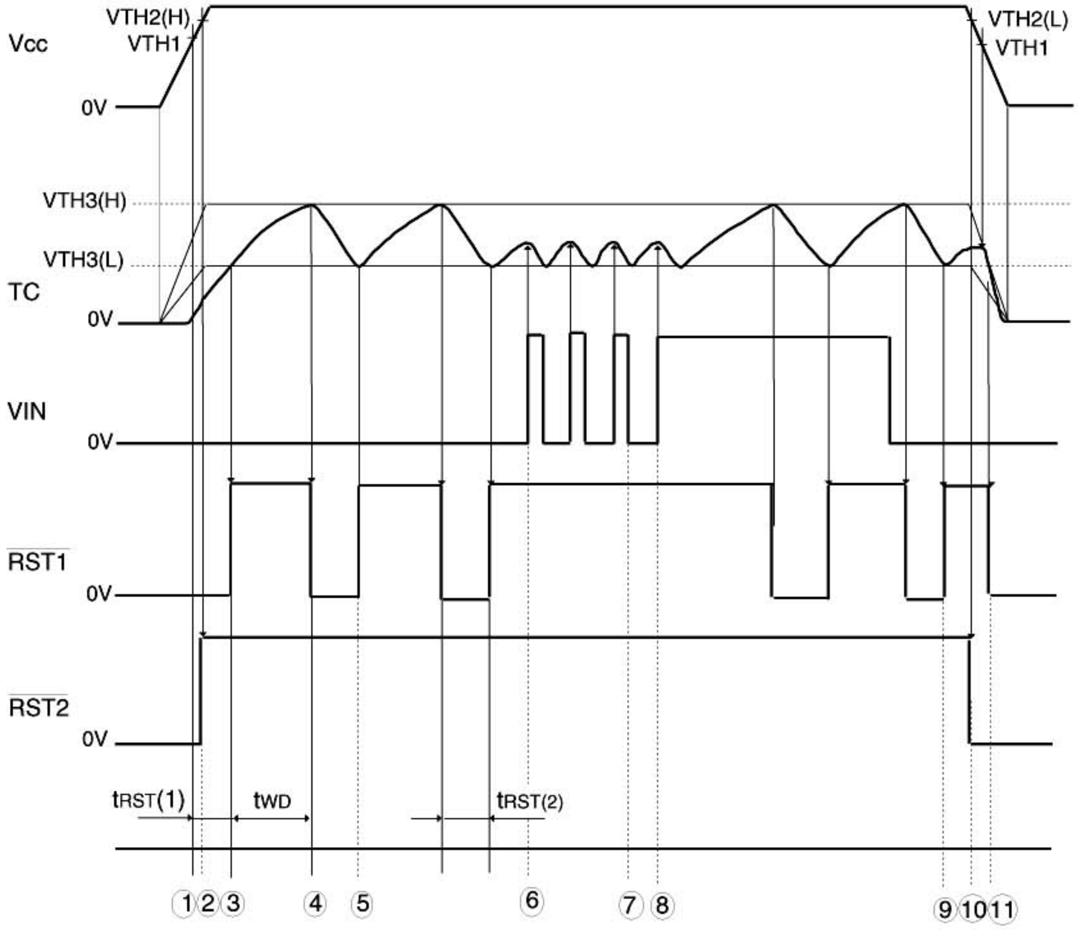
(1)DC FEATURES

Symbol	Parameter	Pin	Test conditions	Limits			Unit
				Min.	Typ.	Max.	
I_{IH}	WD input current	WD	V_{IN}=5V	0.06	0.15	0.25	mA
I_{IL}			V_{IN}=-5V	0.05	-0.1	-0.15	mA
V_{IH}	WD input voltage	WD		2			V
V_{IL}						0.8	V
I_{OUT}	TC output current	TC	V_{IN}=1.5V			-1	μA
I_{IN}	TC input current	TC	V_{OUT}=4.2V		3.3		mA
$V_{VH3(H)}$	Threshold voltage of watch dog timer	TC		3.7	4	4.3	V
$V_{VH3(L)}$				1.7	2	2.3	V
V_{OL}	Output voltage	$\overline{RST1}$	I_{OUT}=1mA		0.1	0.5	V
I_{LEAK}	Output leak current	RST2	V_{OUT}=15V			5	μA
V_{TH1}	Vcc detective voltage(1)	Vcc		4.05	4.25	4.45	V
$V_{TH2(H)}$	Vcc detective voltage(2)	Vcc		4.5	4.7	4.9	V
$V_{TH2(L)}$				4.45	4.6	4.75	V
ΔV_{TH2}				0.05	0.1	0.2	V
V_5	ADJ1 voltage	ADJ1		1.17	1.46	1.75	V
V_8	ADJ2 voltage	ADJ2		1.07	1.34	1.61	V
$\overline{RST1}$	$\overline{RST1}$ on voltage	$\overline{RST1}$	Vcc=1.2V,R_L=4.7k			0.5	V
$\overline{RST2}$	$\overline{RST2}$ on voltage	$\overline{RST2}$	Vcc=1.2V,R_L=4.7k			0.5	V
Icc	Circuit current	Vcc			0.8	1.5	V

(2)AC FEATURES

Symbol	Parameter	Pin	Test conditions	Limits			Unit
				Min.	Typ.	Max.	
t_{WD}	Watch dog timer	$\overline{RST1}$			1.1•C•R1		s
			C=0.1μF,R1=10kΩ	0.5	1.1	1.7	ms
$t_{RST(1)}$	Reset timer (1)	$\overline{RST1}$			0.5•C•R1		s
			C=0.1μF,R1=10kΩ	0.2	0.5	1.1	ms
$t_{RST(2)}$	Reset timer (2)	$\overline{RST1}$	R1=10kΩ		830•C		s
			C=0.1μF,R1=10kΩ	40	83	220	μs
$t_{WD\ IN}$	Input pulse watch	WD		3			μs
t_{d1}	Transmittal delay time	$\overline{RST1}$			20		μs
t_{d2}		$\overline{RST2}$			10		μs

OPERATING EXPLANETION



① The Vcc rises up to 0.8V,then Reset1 and 2 generate Low output,and Rising up to 4.25V,charge of C1 begins.

② The Vcc rises up to 4.7V,then Reset2 generates high.

③,④ The voltage at TC pin is 2V,then Reset2 generates high,when 4V,C1 is discharged and Reset1 generates Low.

⑤ The voltage at TC pin falls to 2V,then Reset1 generates high unless normal clock signal is entered to WD pin,Reset1 repeats this operation.

⑥,⑦ Before the voltage at TC pin reaches 4V,if normal clock signal is entered to WD pin,Low Reset1 is canceled.

⑧,⑨ In the case of entrance of abnormal signal input, as the waveform of TC pin repeats charge and discharge of Reset1 alternatively from 2V to 4V,the Reset1 repeats high and low output operation.

⑩ The Vcc falls to 4.6V,then Reset2 generates Low, this detective voltage has a 100mV hysteresis.

⑪ When Vcc goes down to 4.25V(V_{TH1}),the status of TC pin is switched to discharge.When the potentional at TC pin is detected being V_{TH3}(H) or V_{TH3}(L),the status of Reset1 becomes "low".

TERMINOLOGY

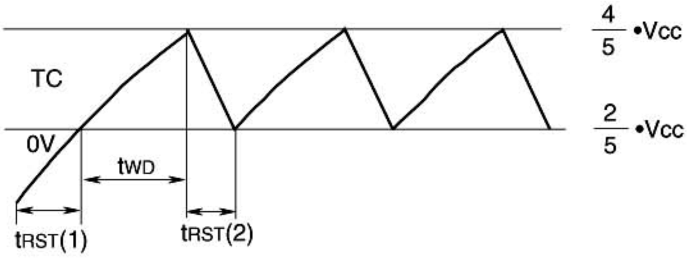
$t_{RST}1$: Time required for TC pin potential to rise from 0V $V_{TH}3(L)$ when Vcc is being applied.

t_{WD}: Time required for TC pin potential to rise from $V_{TH}3(L)$ to $V_{TH}3(H)$.

$t_{RST}2$: Time required for TC pin potential to go down from $V_{TH}3(H)$ to $V_{TH}3(L)$.

1.Pin ② (TC Pin) Charge Time and Discharge Time

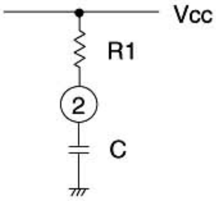
When input to WD pin is abnormal,TC pin output waveform is as shown below:



$t_{RST}(1)=0.51 \cdot C \cdot R1$

$t_{WD}=1.1 \cdot C \cdot R1$ (charge time)

$$t_{RST}(2)=1000 \cdot C \cdot \text{in} \frac{4 \cdot \frac{R1}{1000} -1}{2 \cdot \frac{R1}{1000} -3} \quad \text{(discharge time)}$$

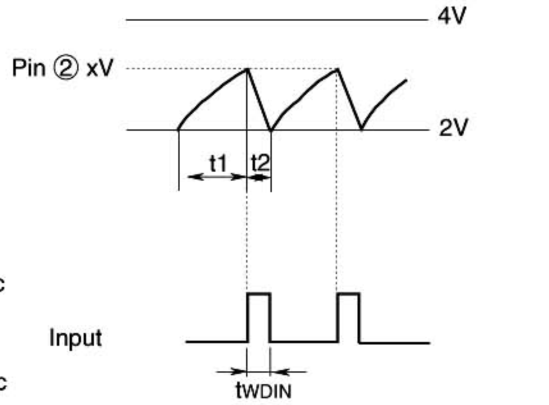


Resistance R1:10kΩ≤R1≤30kΩ

When R1 is 10kΩ, $t_{RST}(2)$ is 830•C.

2.Pin ① (WD Pin) Input Frequency, Input Pulse Width,Charge Time and Discharge Time

When input to WD pin ① is normal,TC pin ② output waveform is as shown below: (Vcc=5V)



$$t1=C \cdot R1 \cdot \text{in} \frac{3}{5-x} \text{(charge time)}$$

$$t2=1000 \cdot C \cdot \text{in} \frac{\left(\frac{R1}{1000}+1\right) x-5}{2 \cdot \frac{R1}{1000} -3} \quad \text{(discharge time)}$$

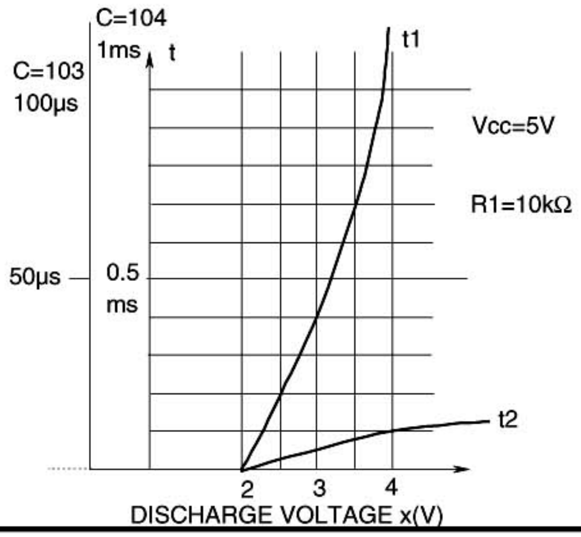
PIN ① (WD PIN)INPUT REQUIREMENTS

(1)Connect capacitor between WD pin and voltage input. (Refer to Section 3.)

(2)Input cycle:No more than t_{WD}
(Discharge should start before voltage at WD pin reaches 4V.)

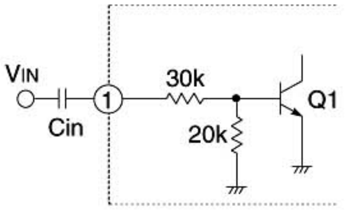
$$\frac{1}{1.1 \cdot C \cdot R1} < f$$

(3)Input pulse width t_{WDIN}:No more than t2



3.Relationship between Input Pulse Width and Input Capacitance Cin

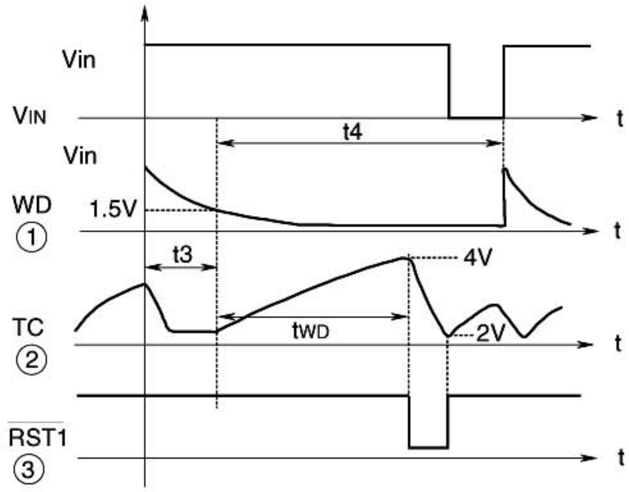
When input to pin ① is 1.5V or more,TC pin discharges electricity. Determine pulse width and input capacitance Cin with reference to the diagram shown on the right.



Q1 is off when voltage at pin ① is 1.5V or less.

$$t3 = Cin \cdot 5X10^{4} \cdot \ln \frac{Vin}{1.5}$$

$\overline{RST1}$ is output when t4 is longer than t_{WD}.

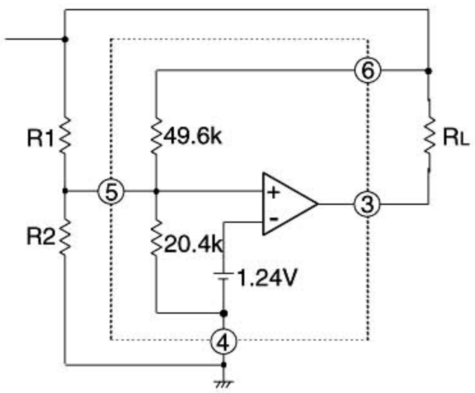


Cin:10.000pF,t3=0.6ms
Cin:1000pF,t3=0.6μs
Cin:100pF,t3=6μs

When t3 is too long,TC pin output waveform frequency changes as shown above.Set t3 to be sufficiently long to turn on Q1[t_{WDIN}(3μs)or more] but not to exceed t2(Discharge time).
(t2:Discharge time during normal input)

4.Vcc Detection Voltage Adjustment

(1)Detection voltage 1(V_{TH1})adjustment.



VTH1(V)	R1(kΩ)	R2(kΩ)	Detection voltage calculation formula
13	10	0.92	$V_{TH1} = \frac{R01+R02}{R02} X1.24(V)$ (R_{01}=R1//49.6kΩ, R_{02}=R2//20.4kΩ)
10	10	1.25	
7	10	1.96	
5	10	3.17	
4.25	—	—	
4	10.90	5	
3.5	8.59	5	

To adjust detection voltage 1,determine external resistance with the following equation:

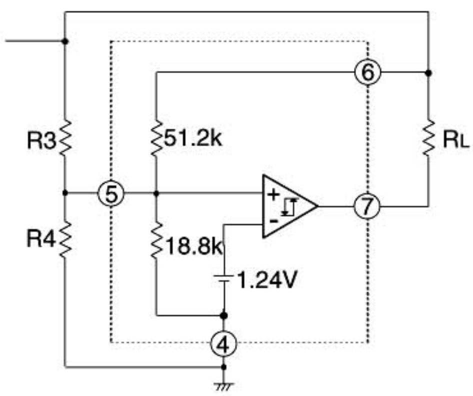
a. V_{TH}>4.25V(R1=10kΩ)

$$R2 = \frac{1}{\frac{1}{R0} - \frac{1}{20.4k}} \quad \left(R0 = \frac{8.322kX1.24}{V_{TH1}-1.24} \right)$$

b. V_{TH1}<4.25V(R2=5kΩ)

$$R1 = \frac{1}{\frac{1}{R0} - \frac{1}{49.6k}} \quad \left(R0 = \frac{(V_{TH1}-1.24)4.016k}{1.24} \right)$$

(2)Detection voltage 2($V_{TH2(L)}$)adjustment



$V_{TH2(L)}$(V)	R3(kΩ)	R4(kΩ)	ΔV_{TH2}(mV)
13	10	0.93	16.3
10	10	1.26	16.3
7	10	1.99	16.3
5	10	3.24	16.3
4.6	—	—	100
4	10.61	5	17.2
3.5	8.38	5	14.1

Detection voltage calculation formula

$$V_{TH2(L)}=\frac{R03+R04}{R04}\times 1.24(V)$$

$$\left(\begin{array}{l}R_{03}=R3//51.2k\Omega \\ R_{04}=R4//18.8k\Omega\end{array}\right)$$

$$\Delta V_{TH2}=\frac{R03}{51.2k}\times 100(mV)$$

To adjust detection voltage 2,determine external resistance with the following equations:

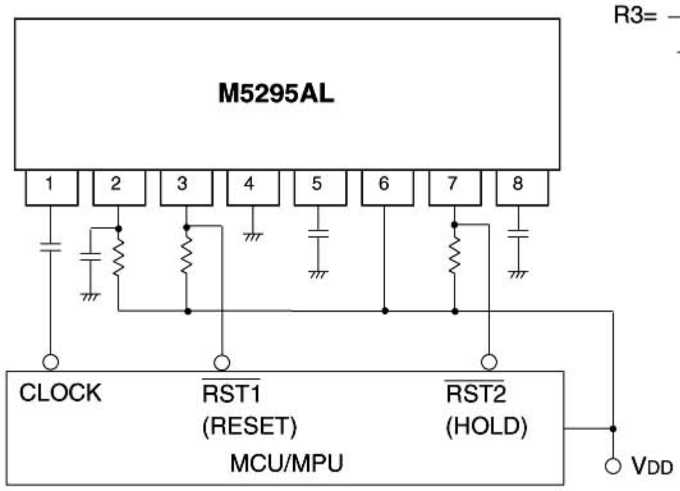
a. $V_{TH2(L)}$>4.6V(R3=10kΩ)

$$R4=\frac{1}{\frac{1}{R0}-\frac{1}{18.8k}} \quad \left(R0=\frac{8.37k\times 1.24}{V_{TH2(L)}-1.24}\right)$$

b. $V_{TH2(L)}$<4.6V(R4=5kΩ)

$$R3=\frac{1}{\frac{1}{R0}-\frac{1}{51.2k}} \quad \left(R0=\frac{(V_{TH2(L)}-1.24)3.95k}{1.24}\right)$$

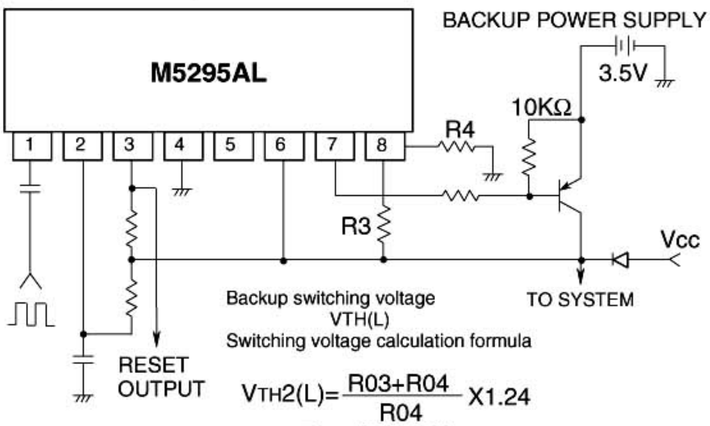
APPLICATION EXAMPLE



OPERATION INSTRUCTIONS

1. When malfunction occurs due to noise or other related trouble,connect capacitance of approximately 1000pF between pin ⑤ and GND as well as pin ⑧ and GND to stabilize operation.
2. To adjust detection voltage,add resistance of 15kΩ or less to both Vcc and GND via adjusting pins. (Set detection voltage to no less than 3V.)
3. Set t_{WD} and $t_{RST}(2)$ as shown below:
   $110\mu s \leq t_{WD} \leq 1.1s$
   $8.3\mu s \leq t_{RST}(2) \leq 83ms$
   $10k\Omega \leq R1 \leq 30k\Omega$
4. Input clock pulses to pin ① via capacitor.To determine capacitance,refer to "Relationship between Input Pulse Width and Input Capacitance Cin".

Example of Backup Circuit with M5295AL



Backup switching voltage $V_{TH(L)}$

Switching voltage calculation formula

$$V_{TH2(L)}=\frac{R03+R04}{R04}\times 1.24$$

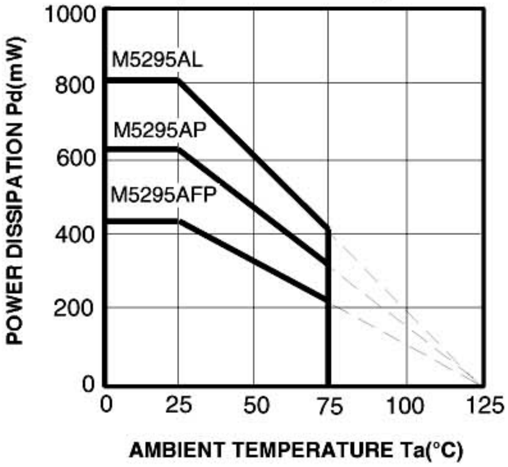
R_{03}=R3//51.2k

R_{04}=R4//18.8k

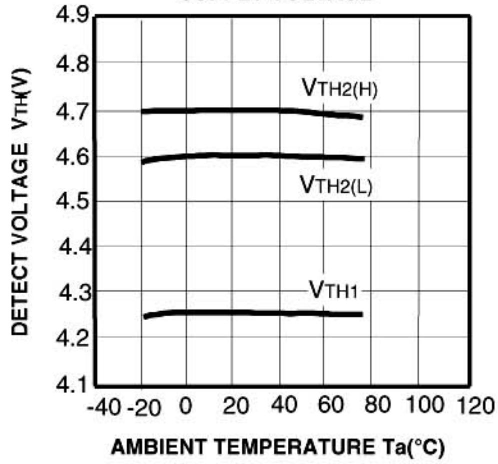
(Note)Set backup switching voltage to be more than or equal to backup supply voltage.

TYPICAL CHARACTERISTICS

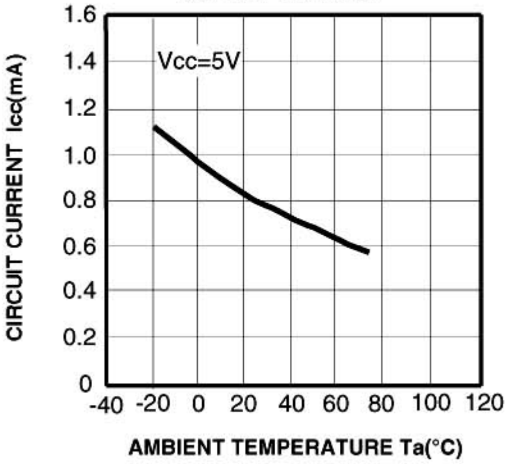
THERMAL DERATING
(MAXIMUM RATING)



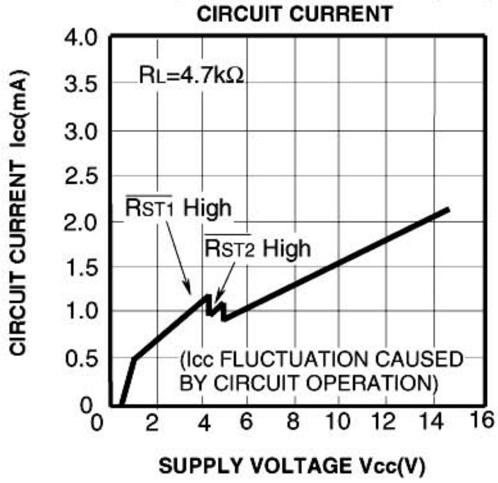
DETECTION VOLTAGE VS.
SUPPLY VOLTAGE



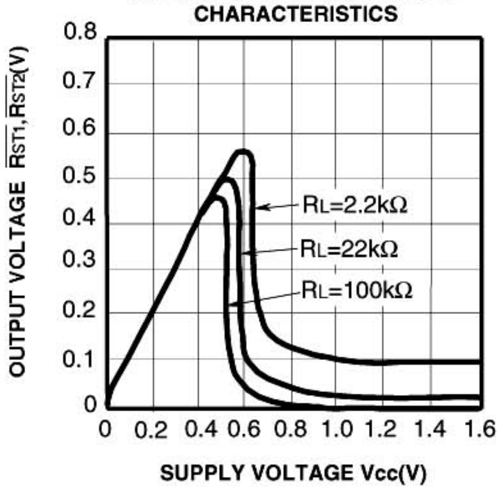
CIRCUIT CURRENT VS.
SUPPLY VOLTAGE



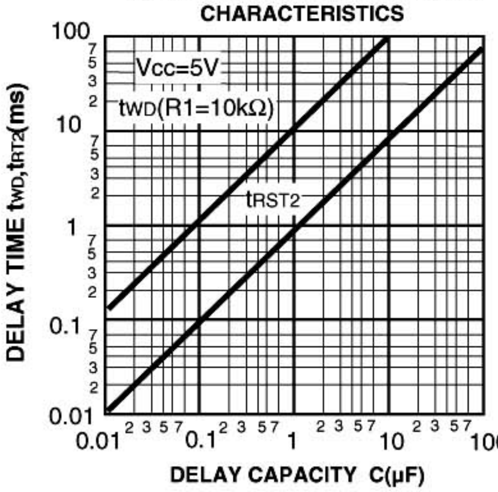
INTERRUPTION OUTPUT VOLTAGE VS.
CIRCUIT CURRENT

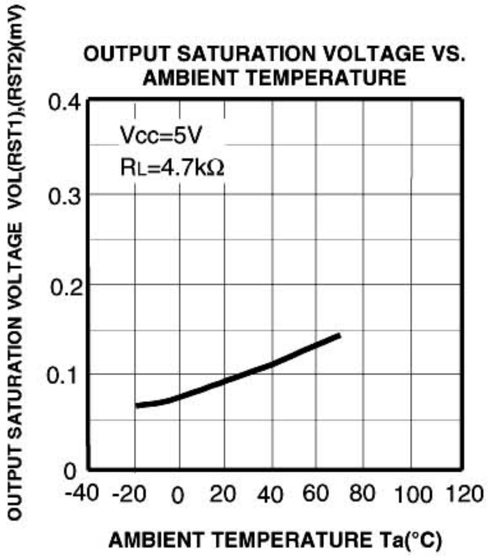


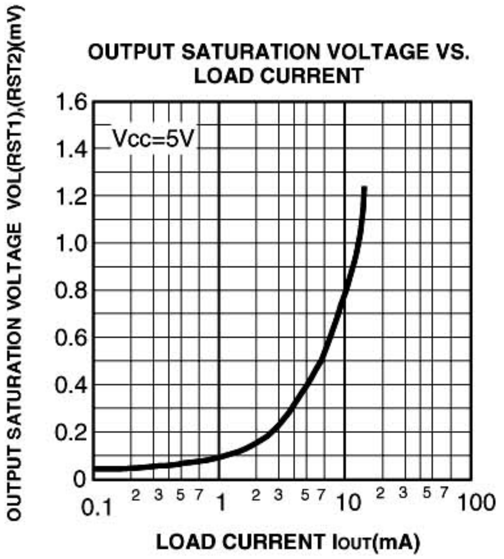
CRITICAL OPERATION VOLTAGE
CHARACTERISTICS

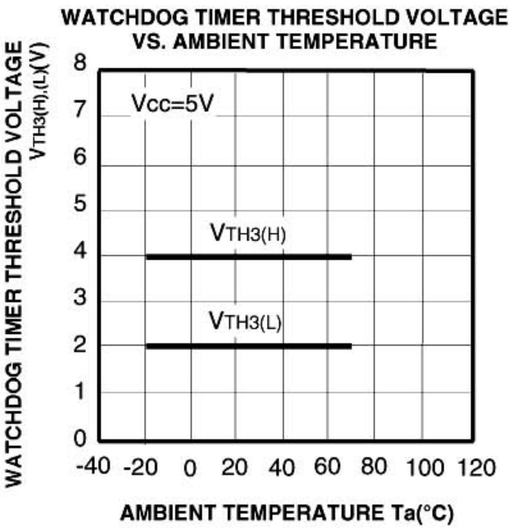


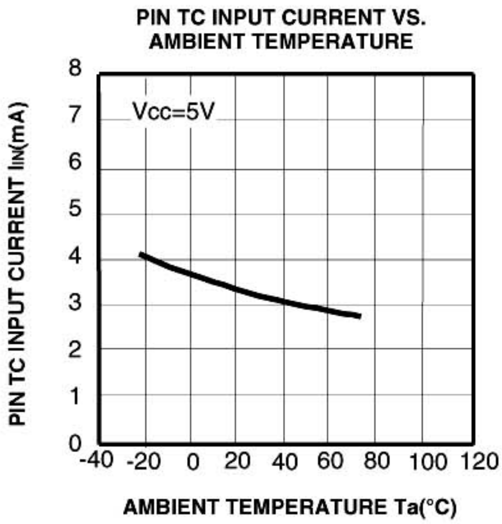
DELAY TIME VS.DELAY CAPACITY
CHARACTERISTICS

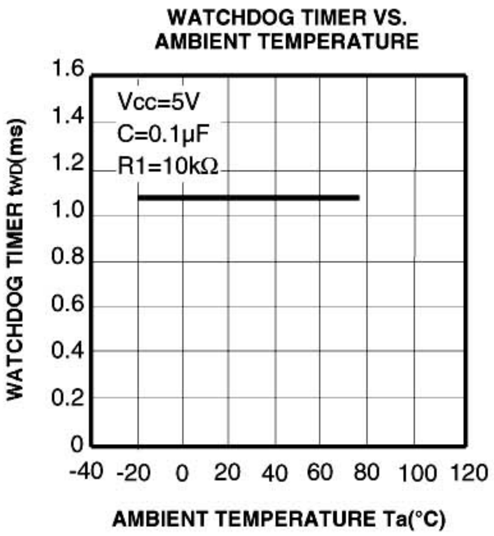


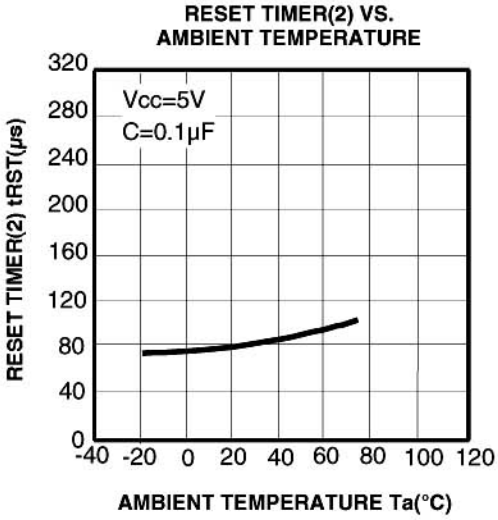

OUTPUT SATURATION VOLTAGE VS. AMBIENT TEMPERATURE
Vcc=5V
RL=4.7kΩ
OUTPUT SATURATION VOLTAGE VOL(RST1),(RST2)(mV)
AMBIENT TEMPERATURE Ta(°C)


OUTPUT SATURATION VOLTAGE VS. LOAD CURRENT
Vcc=5V
OUTPUT SATURATION VOLTAGE VOL(RST1),(RST2)(mV)
LOAD CURRENT IOUT(mA)


WATCHDOG TIMER THRESHOLD VOLTAGE VS. AMBIENT TEMPERATURE
Vcc=5V
VTH3(H)
VTH3(L)
WATCHDOG TIMER THRESHOLD VOLTAGE VTH3(H),(L)(V)
AMBIENT TEMPERATURE Ta(°C)


PIN TC INPUT CURRENT VS. AMBIENT TEMPERATURE
Vcc=5V
PIN TC INPUT CURRENT IIN(mA)
AMBIENT TEMPERATURE Ta(°C)


WATCHDOG TIMER VS. AMBIENT TEMPERATURE
Vcc=5V
C=0.1μF
R1=10kΩ
WATCHDOG TIMER tWD(ms)
AMBIENT TEMPERATURE Ta(°C)


RESET TIMER(2) VS. AMBIENT TEMPERATURE
Vcc=5V
C=0.1μF
RESET TIMER(2) tRST(μs)
AMBIENT TEMPERATURE Ta(°C)