

# 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

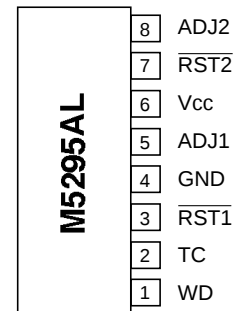
### APPLICATION

Microcomputer Systems

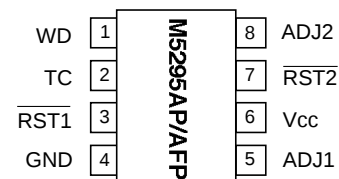
### RECOMMENDED OPERATING CONDITIONS

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

### PIN CONFIGURATION (TOP VIEW)

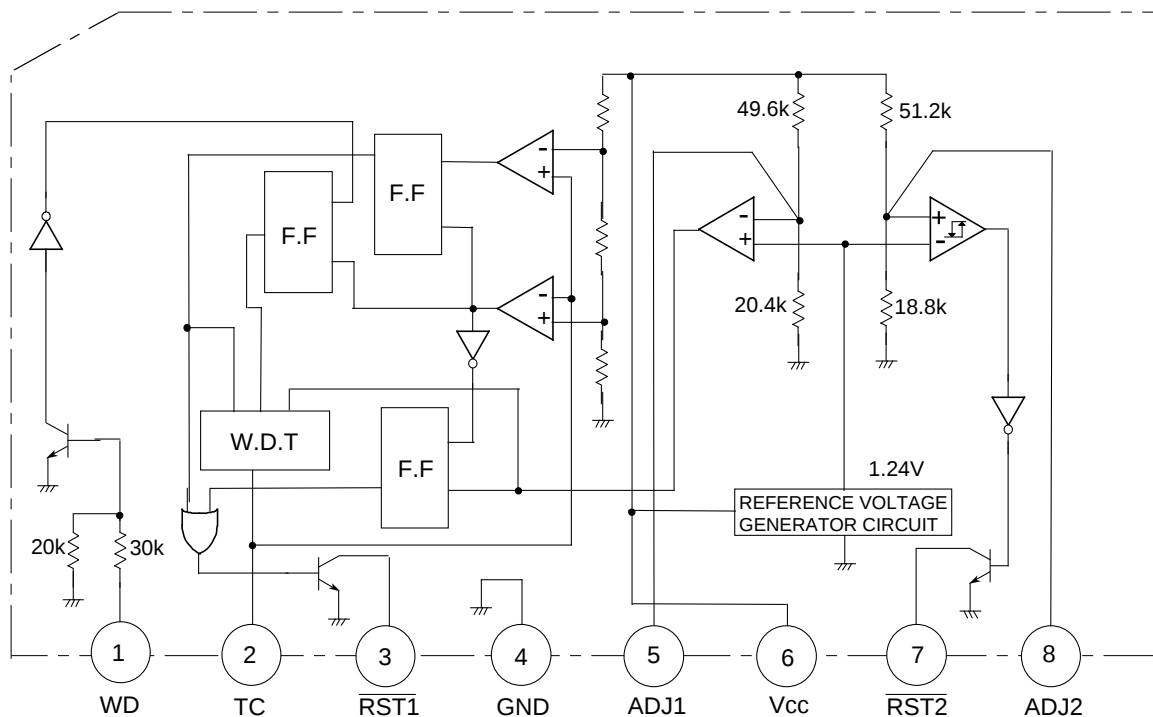


Outline 8P5(AL)



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

### BLOCK DIAGRAM



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## WATCHDOG TIMER

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

| Symbol           | Parameter             | Conditions | Ratings                   | Unit  |
|------------------|-----------------------|------------|---------------------------|-------|
| V <sub>CC</sub>  | Supply voltage        |            | 15                        | V     |
| V <sub>IN</sub>  | Input voltage         |            | -10 to +10                | V     |
| V <sub>OUT</sub> | Output voltage        |            | 15                        | V     |
| I <sub>OUT</sub> | Output current        |            | 10                        | mA    |
| P <sub>d</sub>   | Power dissipation     |            | 800(SIP)/625(DIP)/440(FP) | mW    |
| K <sub>θ</sub>   | Thermal derating      | Ta≥25°C    | 8(SIP)/6.25(DIP)/4.4(FP)  | mW/°C |
| T <sub>opr</sub> | Operating temperature |            | -20 to +75                | °C    |
| T <sub>stg</sub> | Storage temperature   |            | -55 to +125               | °C    |

### ELECTRICAL CHARACTERISTICS (Ta=25°C, V<sub>CC</sub>=5V, unless otherwise noted)

#### (1)DC FEATURES

| Symbol                   | Parameter                            | Pin                      | Test conditions                             | Limits |      |       | Unit |
|--------------------------|--------------------------------------|--------------------------|---------------------------------------------|--------|------|-------|------|
|                          |                                      |                          |                                             | Min.   | Typ. | Max.  |      |
| I <sub>IH</sub>          | WD input current                     | WD                       | V <sub>IN</sub> =5V                         | 0.06   | 0.15 | 0.25  | mA   |
| I <sub>IL</sub>          |                                      |                          | V <sub>IN</sub> =-5V                        | 0.05   | -0.1 | -0.15 | mA   |
| V <sub>IH</sub>          | WD input voltage                     | WD                       |                                             | 2      |      |       | V    |
| V <sub>IL</sub>          |                                      |                          |                                             |        |      | 0.8   | V    |
| I <sub>OUT</sub>         | TC output current                    | TC                       | V <sub>IN</sub> =1.5V                       |        |      | -1    | μA   |
| I <sub>IN</sub>          | TC input current                     | TC                       | V <sub>OUT</sub> =4.2V                      |        | 3.3  |       | mA   |
| V <sub>VH3(H)</sub>      | Threshold voltage of watch dog timer | TC                       |                                             | 3.7    | 4    | 4.3   | V    |
| V <sub>VH3(L)</sub>      |                                      |                          |                                             | 1.7    | 2    | 2.3   | V    |
| V <sub>OL</sub>          | Output voltage                       | $\overline{\text{RST1}}$ | I <sub>OUT</sub> =1mA                       |        | 0.1  | 0.5   | V    |
| I <sub>LEAK</sub>        | Output leak current                  | $\overline{\text{RST2}}$ | V <sub>OUT</sub> =15V                       |        |      | 5     | μA   |
| V <sub>TH1</sub>         | V <sub>CC</sub> detective voltage(1) | V <sub>CC</sub>          |                                             | 4.05   | 4.25 | 4.45  | V    |
| V <sub>TH2(H)</sub>      | V <sub>CC</sub> detective voltage(2) | V <sub>CC</sub>          |                                             | 4.5    | 4.7  | 4.9   | V    |
| V <sub>TH2(L)</sub>      |                                      |                          |                                             | 4.45   | 4.6  | 4.75  | V    |
| DV <sub>TH2</sub>        |                                      |                          |                                             | 0.05   | 0.1  | 0.2   | V    |
| V <sub>5</sub>           | ADJ1 voltage                         | ADJ1                     |                                             | 1.17   | 1.46 | 1.75  | V    |
| V <sub>8</sub>           | ADJ2 voltage                         | ADJ2                     |                                             | 1.07   | 1.34 | 1.61  | V    |
| $\overline{\text{RST1}}$ | $\overline{\text{RST1}}$ on voltage  | $\overline{\text{RST1}}$ | V <sub>CC</sub> =1.2V, R <sub>L</sub> =4.7k |        |      | 0.5   | V    |
| $\overline{\text{RST2}}$ | $\overline{\text{RST2}}$ on voltage  | $\overline{\text{RST2}}$ | V <sub>CC</sub> =1.2V, R <sub>L</sub> =4.7k |        |      | 0.5   | V    |
| I <sub>CC</sub>          | Circuit current                      | V <sub>CC</sub>          |                                             |        | 0.8  | 1.5   | V    |

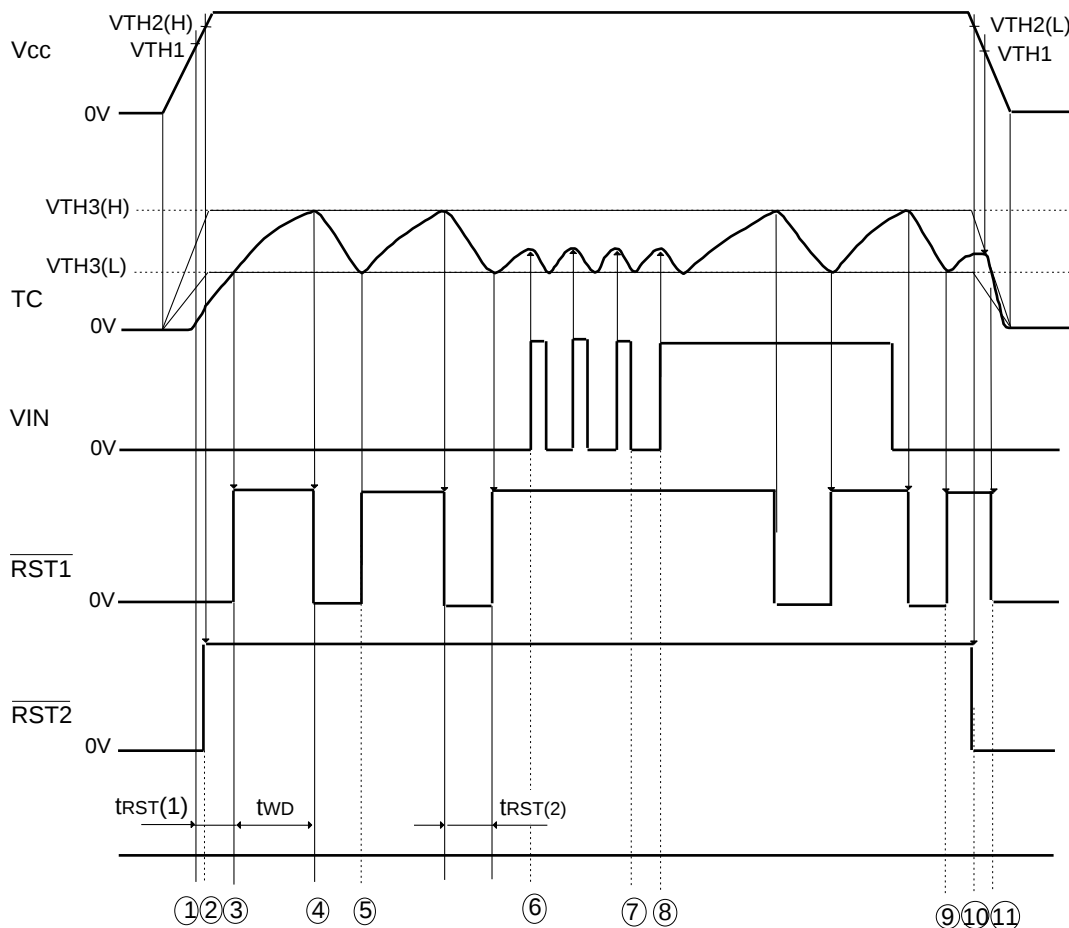
#### (2)AC FEATURES

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

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## WATCHDOG TIMER

### OPERATING EXPLANATION



- ① The Vcc rises up to 0.8V, then  $\overline{\text{Reset1}}$  and 2 generate Low output, and rising up to 4.25V, charge of C1 begins.
- ② The Vcc rises up to 4.7V, then  $\overline{\text{Reset2}}$  generates high.
- ③, ④ The voltage at TC pin is 2V, then  $\overline{\text{Reset2}}$  generates high, when 4V, C1 is discharged and  $\overline{\text{Reset1}}$  generates Low.
- ⑤ The voltage at TC pin falls to 2V, then  $\overline{\text{Reset1}}$  generates high unless normal clock signal is entered to WD pin,  $\overline{\text{Reset1}}$  repeats this operation.
- ⑥, ⑦ Before the voltage at TC pin reaches 4V, if normal clock signal is entered to WD pin, Low  $\overline{\text{Reset1}}$  is canceled.
- ⑧, ⑨ In the case of entrance of abnormal signal input, as the waveform of TC pin repeats charge and discharge of  $\overline{\text{Reset1}}$  alternatively from 2V to 4V, the  $\overline{\text{Reset1}}$  repeats high and low output operation.
- ⑩ The Vcc falls to 4.6V, then  $\overline{\text{Reset2}}$  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 potential at TC pin is detected being  $V_{TH3}(H)$  or  $V_{TH3}(L)$ , the status of  $\overline{\text{Reset1}}$  becomes "low".

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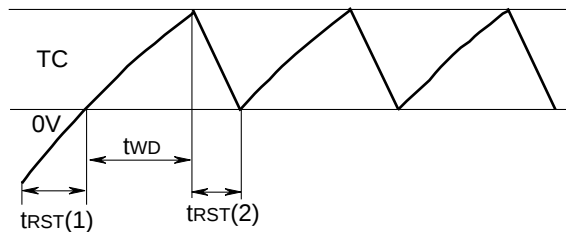
## WATCHDOG TIMER

### TERMINOLOGY

- $t_{RST1}$ : Time required for TC pin potential to rise from 0V  $V_{TH3}(L)$  when  $V_{CC}$  is being applied.  
 $t_{WD}$ : Time required for TC pin potential to rise from  $V_{TH3}(L)$  to  $V_{TH3}(H)$ .  
 $t_{RST2}$ : Time required for TC pin potential to go down from  $V_{TH3}(H)$  to  $V_{TH3}(L)$ .

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

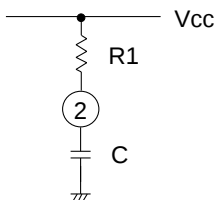
When input to WD pin is abnormal, TC pin output waveform is as shown below:



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

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

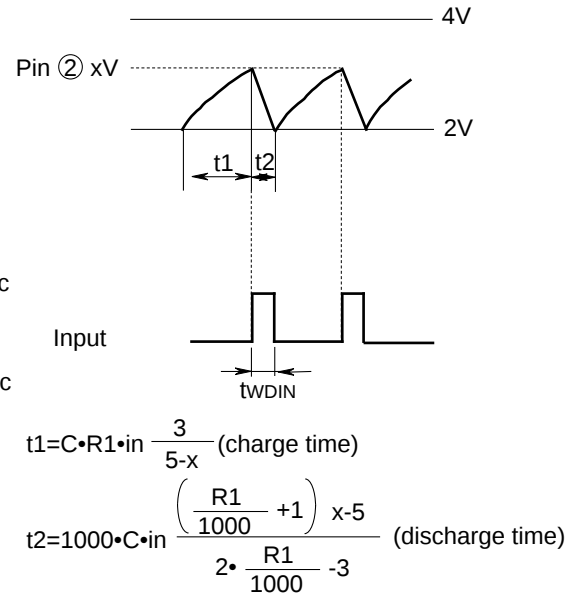
$$t_{RST(2)} = 1000 \cdot C \cdot \ln \frac{4 \cdot \frac{R1}{1000} - 1}{2 \cdot \frac{R1}{1000} - 3} \text{ (discharge time)}$$



Resistance  $R1$ : 10kW  $\leq R1 \leq$  30kW  
 When  $R1$  is 10kW,  $t_{RST(2)}$  is  $830 \cdot C$ .

### 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: ( $V_{CC}=5V$ )

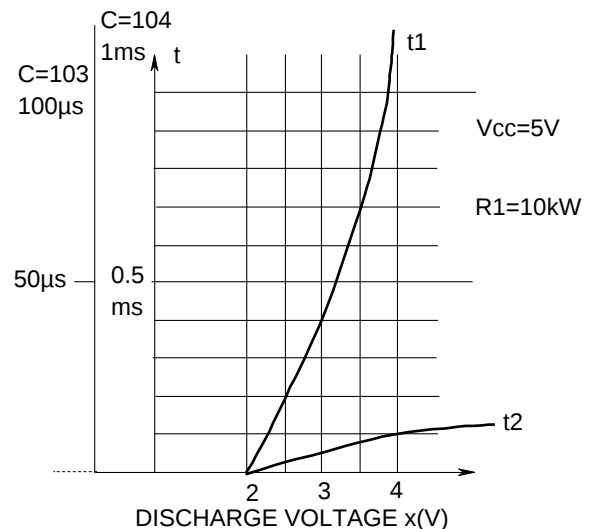


#### PIN ① (WD PIN) INPUT REQUIREMENTS

- (1) Connect capacitor between WD pin and voltage input.  
(Refer to Section 3.)
- (2) Input cycle: No more than two  
(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  $t2$

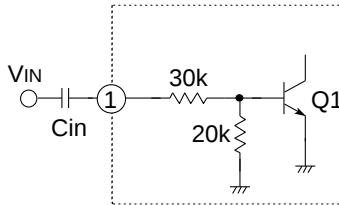


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### 3.Relationship between Input Pulse Width and Input Capacitance Cin

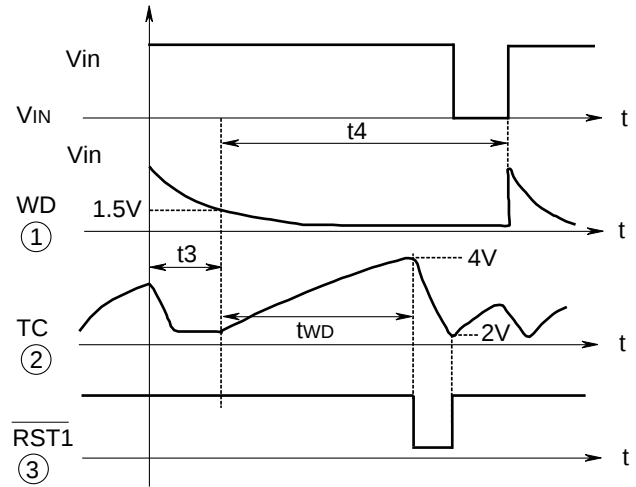
When input to pin ① is 1.5V or more, TC pin discharges electricity. Determine pulse width and input capacitance Cin with reference to the diagram shown on the right.



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

$$t3 = Cin \cdot 5 \times 10^4 \cdot \ln \frac{Vin}{1.5}$$

RST1 is output when t4 is longer than twd.



Cin:10.000pF, t3=0.6ms

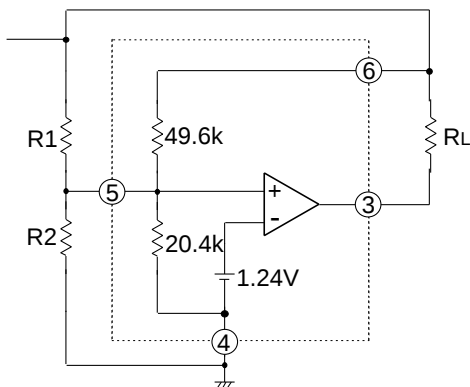
Cin:1000pF, t3=0.6μs

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[twDIN(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(VTH1)adjustment.



| VTH1(V) | R1(kW) | R2(kW) | Detection voltage calculation formula                                                                                                   |
|---------|--------|--------|-----------------------------------------------------------------------------------------------------------------------------------------|
| 13      | 10     | 0.92   | $V_{TH1} = \frac{R01 + R02}{R02} \times 1.24(V)$ $\left( \begin{array}{l} R01 = R1 // 49.6kW \\ R02 = R2 // 20.4kW \end{array} \right)$ |
| 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.  $V_{TH1} > 4.25V$  ( $R1 = 10kW$ )

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

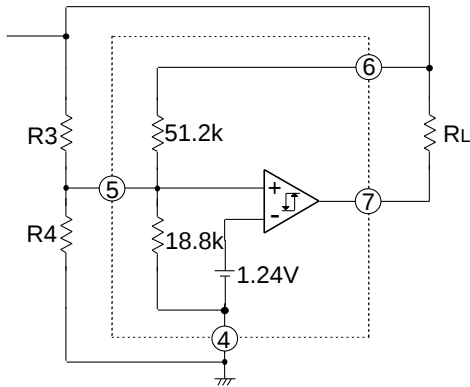
b.  $V_{TH1} < 4.25V$  ( $R2 = 5kW$ )

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

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



| $V_{TH2}(L)(V)$ | $R3(k\Omega)$ | $R4(k\Omega)$ | $DV_{TH2}(mV)$ | Detection voltage calculation formula                                                                                                      |
|-----------------|---------------|---------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| 13              | 10            | 0.93          | 16.3           | $V_{TH2}(L) = \frac{R03+R04}{R04} \times 1.24(V)$ $\left( \begin{array}{l} R03=R3//51.2k\Omega \\ R04=R4//18.8k\Omega \end{array} \right)$ |
| 10              | 10            | 1.26          | 16.3           |                                                                                                                                            |
| 7               | 10            | 1.99          | 16.3           |                                                                                                                                            |
| 5               | 10            | 3.24          | 16.3           |                                                                                                                                            |
| 4.6             | —             | —             | 100            | $DV_{TH2} = \frac{R03}{51.2k} \times 100(mV)$                                                                                              |
| 4               | 10.61         | 5             | 17.2           |                                                                                                                                            |
| 3.5             | 8.38          | 5             | 14.1           |                                                                                                                                            |

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

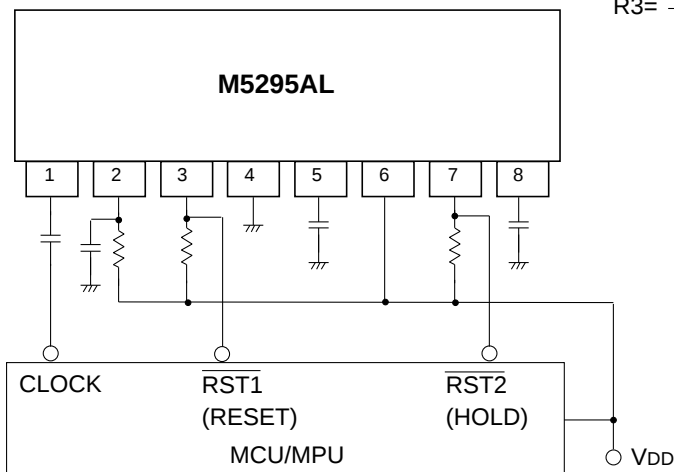
a.  $V_{TH2}(L) > 4.6V (R3=10k\Omega)$

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

b.  $V_{TH2}(L) < 4.6V (R4=5k\Omega)$

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

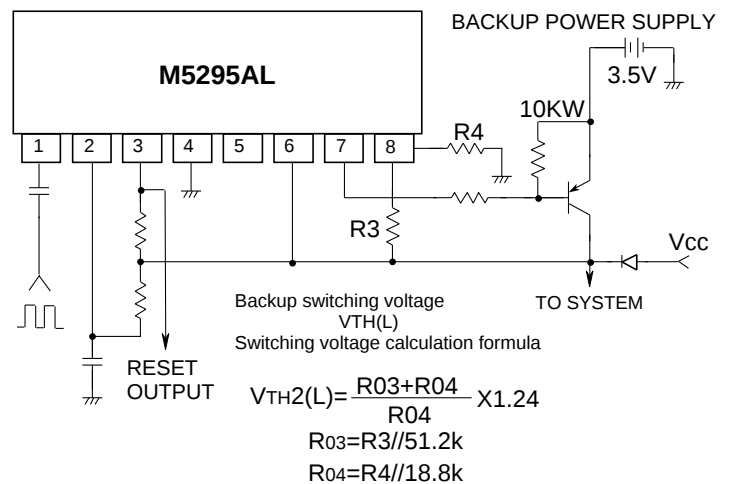
### APPLICATION EXAMPLE



### OPERATION INSTRUCTIONS

- 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.
- To adjust detection voltage,add resistance of 15k $\Omega$  or less to both Vcc and GND via adjusting pins.  
(Set detection voltage to no less than 3V.)
- Set two and tRST(2) as shown below:  
110 $\mu s$   $\leq$  tWDT  $\leq$  1.1s  
8.3 $\mu s$   $\leq$  tRST(2)  $\leq$  83ms  
10k $\Omega$   $\leq$  R1  $\leq$  30k $\Omega$
- Input clock pulses to pin ① via capacitor.To determine capacitance,refer to "Relationship between Input Pulse Width and Input Capacitance C<sub>in</sub>".

### Example of Backup Circuit with M5295AL

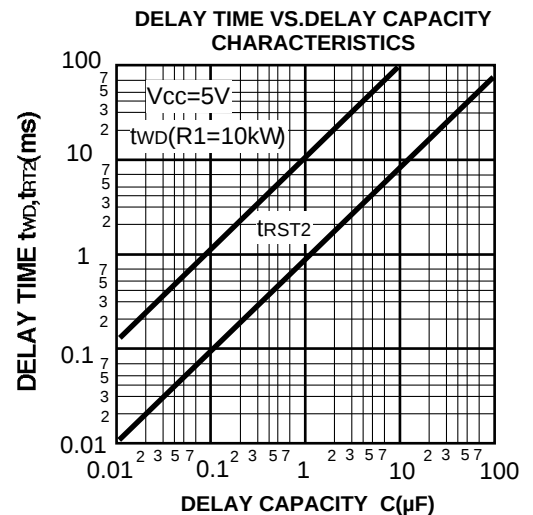
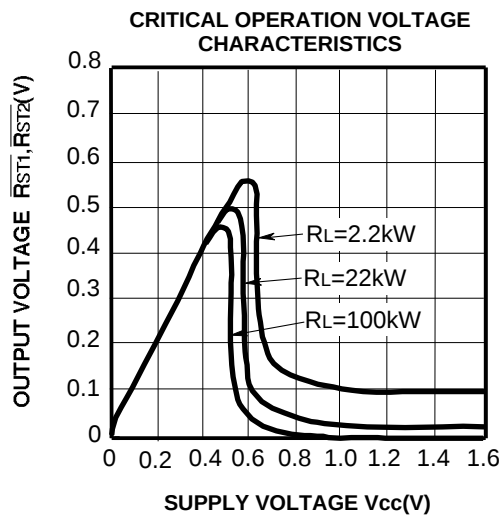
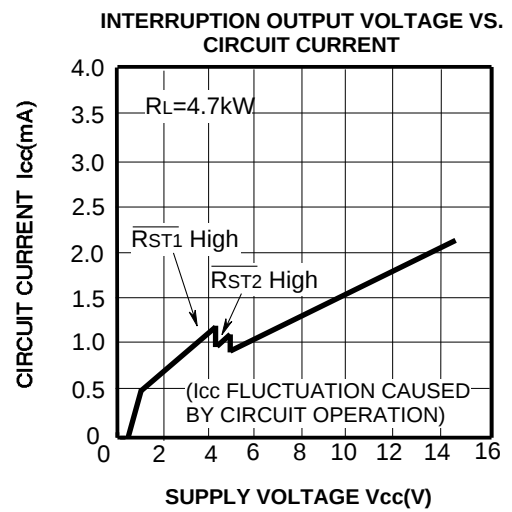
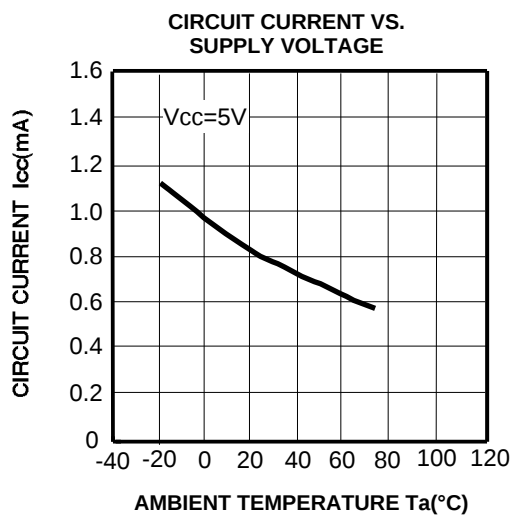
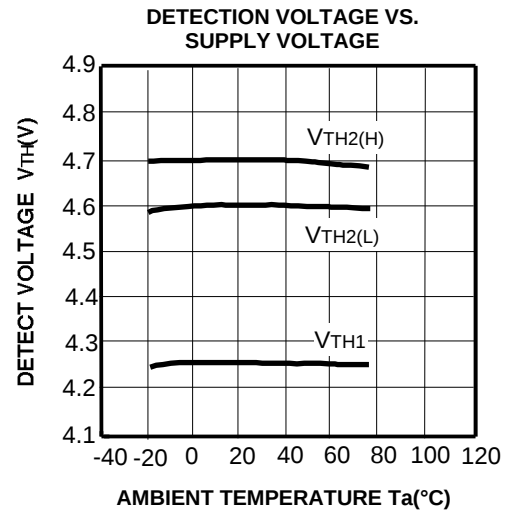
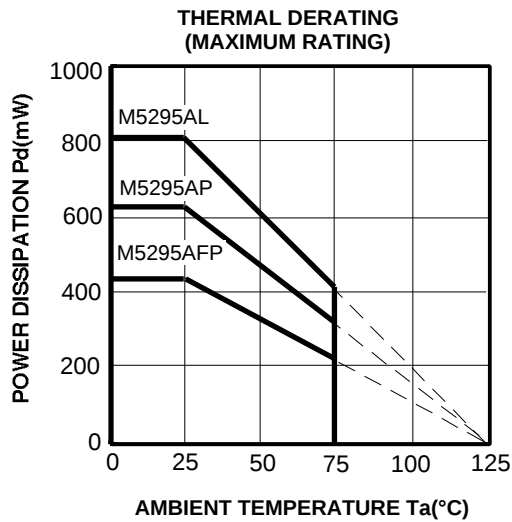


(Note)Set backup switching voltage to be more than or equal to backup supply voltage.

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### TYPICAL CHARACTERISTICS



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