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, V_{CC} = 5V)
- Wide Range of power supply

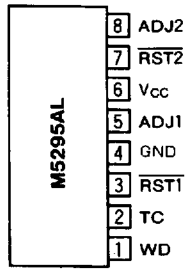
APPLICATION

Microcomputer Systems

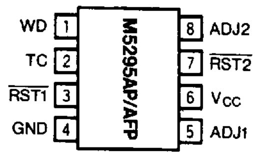
RECOMMENDED OPERATING CONDITIONS

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

PIN CONFIGURATION (TOP VIEW)

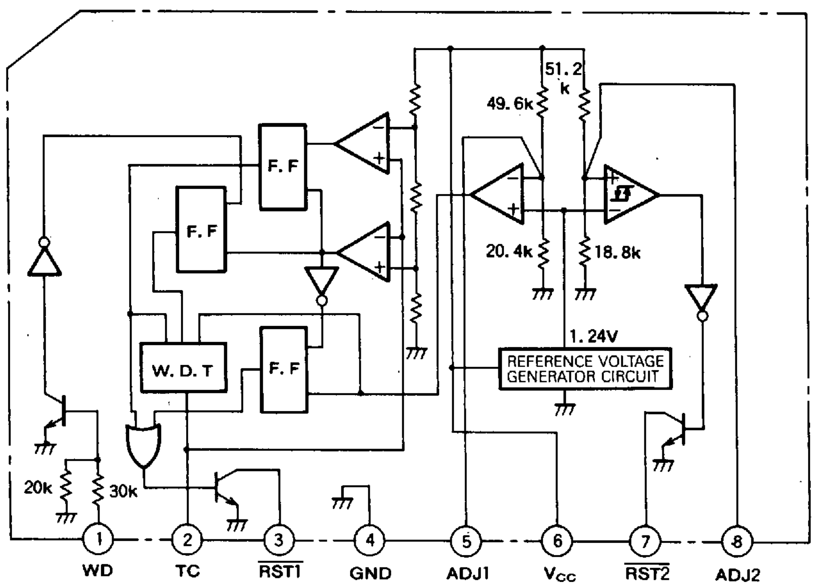


Outline 8P5(L)



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

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (Ta=25℃, 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℃	8(SIP)/6.25(DIP)/4.4(FP)	mW/℃
Topr	Operating temperature		−20 to +75	℃
Tstg	Strage temperature		−55 to +125	℃

ELECTRICAL CHARACTERISTICS (Ta=25℃, VCC=5V, unless otherwise noted)

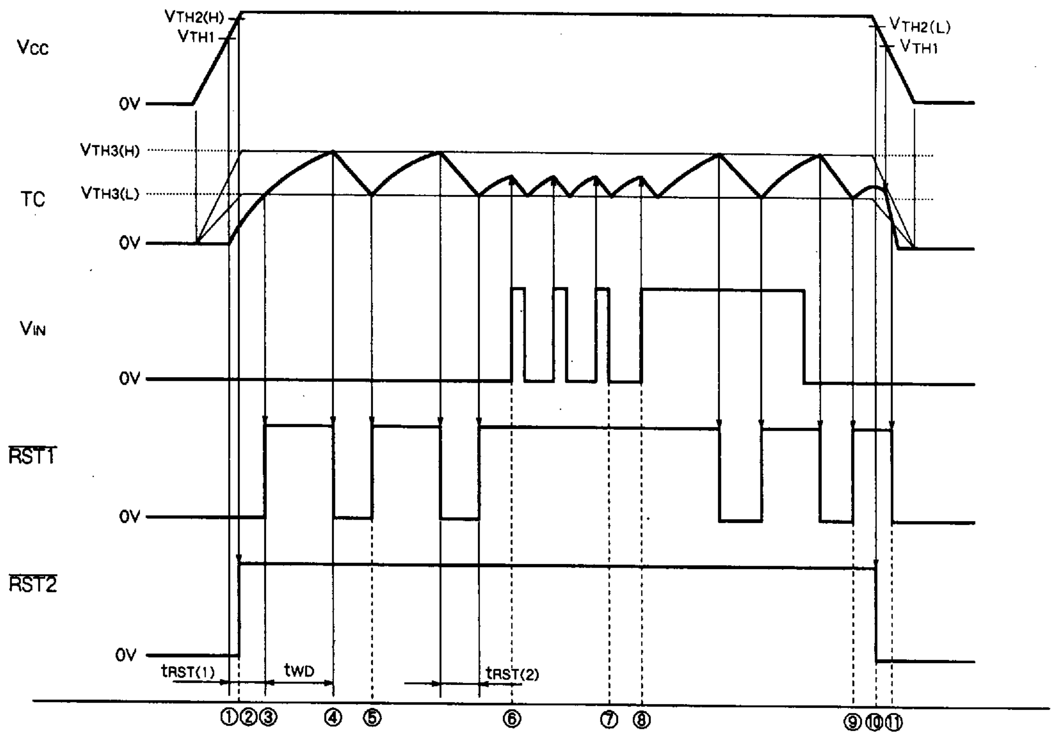
(1) DC FEATURES

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}	WD Input current	WD	V_{IN}=−5V	0.05	−0.1	−0.15	mA
V_{IH}	WD Input voltage	WD		2			V
V_{IL}	WD Input voltage	WD				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
$V_{TH3(L)}$	Threshold voltage of watch dog timer	TC		1.7	2	2.3	V
V_{OL}	Output voltage	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
$V_{TH2(L)}$	Vcc detective voltage (2)	Vcc		4.45	4.6	4.75	V
ΔV_{TH2}	Vcc detective voltage (2)	Vcc		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	$\overline{RST1}$	V_{CC}=1.2V, R_L=4.7K			0.5	V
$\overline{RST2}$	$\overline{RST2}$ on voltage	$\overline{RST2}$	V_{CC}=1.2V, R_L=4.7K			0.5	V
I_{CC}	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
t_{WD}	Watch dog timer	$\overline{RST1}$	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
$t_{RST(1)}$	Reset timer (1)	$\overline{RST1}$	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
$t_{RST(2)}$	Reset timer (2)	$\overline{RST1}$	C=0.1μF, R1=10kΩ	40	83	220	μs
$t_{WD\ IN}$	Input pulse wictth	WD		3			μs
t_{d1}	Transmittal delay time	$\overline{RST1}$			20		μs
t_{d2}	Transmittal delay time	$\overline{RST2}$			10		μs

OPERATING EXPLANATION



① The V_{CC} rises up to 0.8V, then $\overline{\text{Reset1}}$ and 2 generate Low output, and Rising up to 4.25V, charge of C_1 begins.

② The V_{CC} rises up to 4.7V, then $\overline{\text{Reset2}}$ generates high.

③, ④ The voltage at TC pin is 2V, then $\overline{\text{Reset1}}$ generates high, when 4V, C_1 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 cancelled.

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 V_{CC} falls to 4.6V, then $\overline{\text{Reset2}}$ generates Low, this detective voltage has a 100mV hysteresis.

⑪ When V_{CC} 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 $\overline{\text{Reset 1}}$ becomes "low".

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TERMINOLOGY

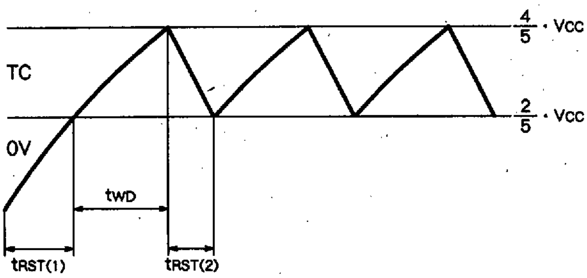
t_{RST1}: Time required for TC pin potential to rise from 0V to $V_{TH3(L)}$ when V_{CC} is being applied.

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

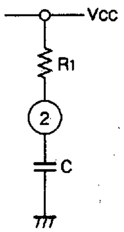
When input to WD pin is abnormal, TC pin output waveform is as shown below:



$t_{RST(1)} = 0.51 \cdot C \cdot R_1$

$t_{WD} = 1.1 \cdot C \cdot R_1$ (charge time)

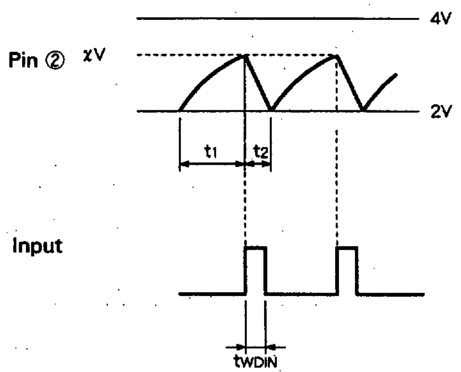
$$t_{RST(2)} = 1000 \cdot C \cdot \ln \frac{4 \cdot \frac{R_1}{1000} - 1}{2 \cdot \frac{R_1}{1000} - 3} \quad \text{(discharge time)}$$



Resistance R_1: $10k\Omega \leqq R_1 \leqq 30k\Omega$
When R_1 is $10k\Omega$, $t_{RST(2)}$ 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)



$$t_1 = C \cdot R_1 \cdot \ln \frac{3}{5-\chi} \quad \text{(charge time)}$$

$$t_2 = 1000 \cdot C \cdot \ln \frac{\left(\frac{R_1}{1000} + 1\right)\chi - 5}{2 \cdot \frac{R_1}{1000} - 3} \quad \text{(discharge time)}$$

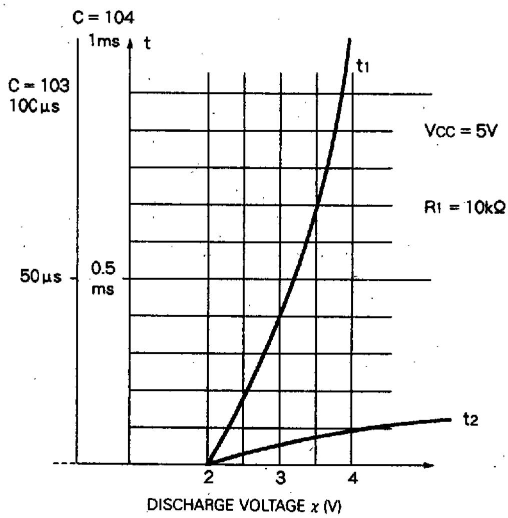
PIN ① (WD PIN) INPUT REQUIREMENTS

(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.)

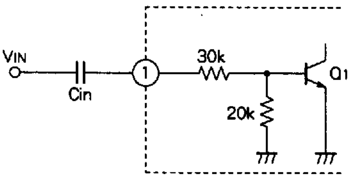
$$\frac{1}{1.1 \cdot C \cdot R_1} < f$$

(3) Input pulse width t_{WDIN}: No more than t_2



3. Relationship between Input Pulse Width and Input Capacitance C_{in}

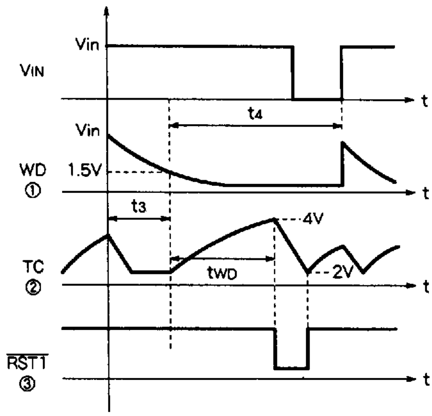
When input to pin ① is 1.5V or more, TC pin discharges electricity. Determine pulse width and input capacitance C_{in} with reference to the diagram shown on the right:



Q_1 is off when voltage at pin ① is 1.5V or less.

$$t_3 = C_{in} \cdot 5 \times 10^4 \cdot \ln \frac{Vin}{1.5}$$

$\overline{RST1}$ is output when t_4 is longer than t_{WD}.

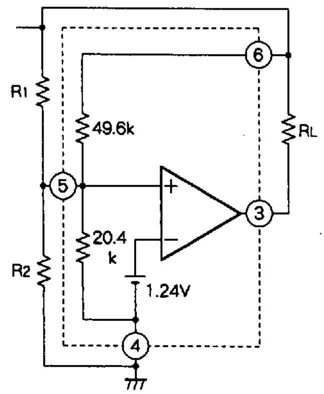


C_{in}: 10,000pF, t_3=0.6ms
C_{in}: 1000pF, t_3=0.6μs
C_{in}: 100pF, t_3=6μs

When t_3 is too long, TC pin output waveform frequency changes as shown above. Set t_3 to be sufficiently long to turn on Q_1 [t_{WDIN} (3μs) or more] but not to exceed t_2 (discharge time).
(t_2: Discharge time during normal input)

4. V_{CC} Detection Voltage Adjustment

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



V_{TH1}(V)	R_1(kΩ)	R_2(kΩ)	Detection voltage calculation formula
13	10	0.92	$V_{TH1} = \frac{R_{01}+R_{02}}{R_{02}} \times 1.24(V)$
10	10	1.25	
7	10	1.96	
5	10	3.17	
4.25	—	—	$\left(\begin{array}{l} R_{01}=R_1 /\!/ 49.6k\Omega \\ R_{02}=R_2 /\!/ 20.4k\Omega \end{array}\right)$
4	10.90	5	
3.5	8.59	5	

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

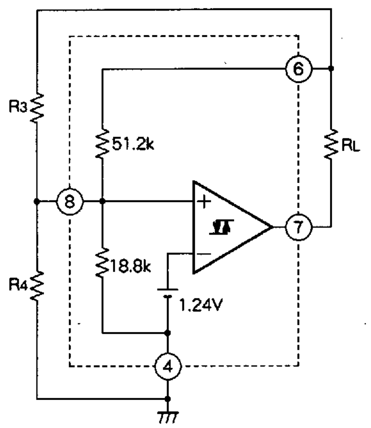
a. V_{TH}>4.25V (R_1=10kΩ)

$$R_2 = \frac{1}{\frac{1}{R_0} - \frac{1}{20.4k}} \qquad \left(R_0 = \frac{8.322k \times 1.24}{V_{TH1} - 1.24}\right)$$

b. V_{TH1}<4.25V (R_2=5kΩ)

$$R_1 = \frac{1}{\frac{1}{R_0} - \frac{1}{49.6k}} \qquad \left(R_0 = \frac{(V_{TH1} - 1.24)4.016k}{1.24}\right)$$

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



$V_{TH2(L)}$(V)	R_3(kΩ)	R_4(kΩ)	ΔV_{TH2}(mV)	Detection voltage calculation formula
13	10	0.93	16.3	$V_{TH2(L)} = \frac{R_{03}+R_{04}}{R_{04}} \times 1.24$(V)
10	10	1.26	16.3	
7	10	1.99	16.3	($R_{03} = R_3 // 51.2k\Omega$, $R_{04} = R_4 // 18.8k\Omega$)
5	10	3.24	16.3	
4.6	—	—	100	
4	10.61	5	17.2	$\Delta V_{TH2} = \frac{R_{03}}{51.2k} \times 100$ (mV)
3.5	8.38	5	14.1	

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

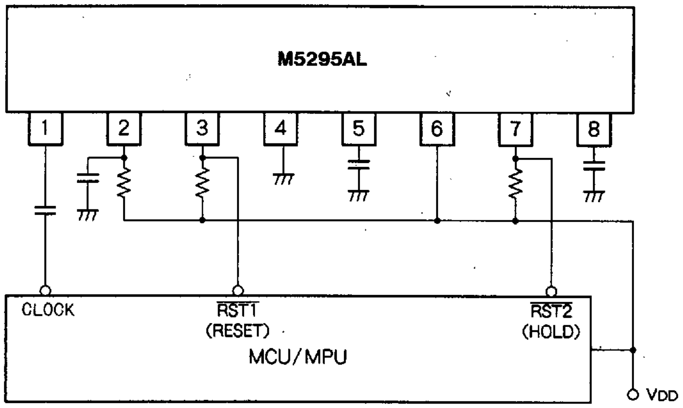
a. $V_{TH2(L)} > 4.6V$ ($R_3 = 10k\Omega$)

$$R_4 = \frac{1}{\frac{1}{R_0} - \frac{1}{18.8k}} \quad \left(R_0 = \frac{8.37k \times 1.24}{V_{TH2(L)} - 1.24}\right)$$

b. $V_{TH2(L)} < 4.6V$ ($R_4 = 5k\Omega$)

$$R_3 = \frac{1}{\frac{1}{R_0} - \frac{1}{51.2k}} \quad \left(R_0 = \frac{(V_{TH2(L)} - 1.24)3.95k}{1.24}\right)$$

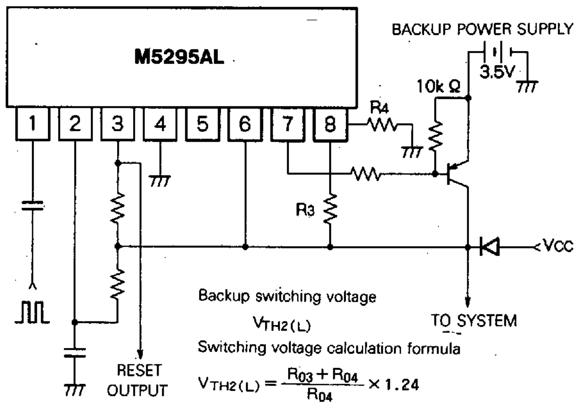
APPLICATION EXAMPLE



OPERATION INSTRUCTIONS

1. When malfunction occurs due to noise or other related trouble, connect capacitance of approximately 1000 pF 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 V_{CC} and GND via adjusting pins. (Set detection voltage to no less than 3V.)
3. Set t_{WD} and $t_{RST(2)}$ as shown below:
   $110\mu s \leqq t_{WD} \leqq 1.1S$
   $8.3\mu s \leqq t_{RST(2)} \leqq 83ms$
   $10k\Omega \leqq R_1 \leqq 30k\Omega$
4. Input clock pulses to pin ① via capacitor. To determine capacitance, refer to "Relationship between Input Pulse Width and Input Capacitance C_{in}".

Example of Backup Circuit with M5295AL



Backup switching voltage

$V_{TH2(L)}$

Switching voltage calculation formula

$$V_{TH2(L)} = \frac{R_{03}+R_{04}}{R_{04}} \times 1.24$$

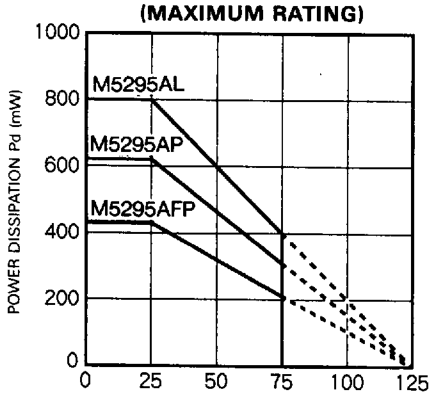
$R_{03} = R_3 // 51.2k$

$R_{04} = R_4 // 18.8k$

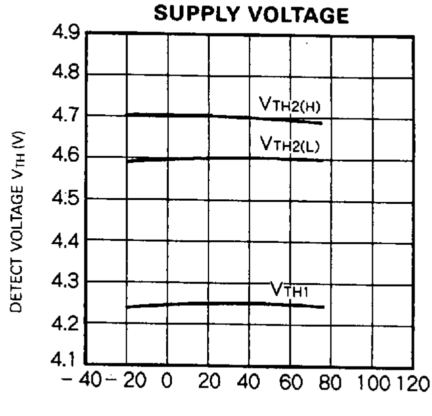
(Note) Set backup switching voltage to be more than or equal to backup supply voltage.

TYPICAL CHARACTERISTICS

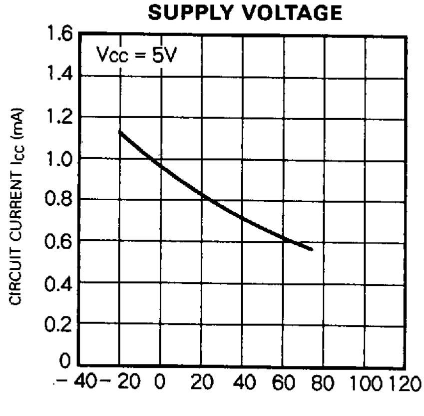
THERMAL DERATING (MAXIMUM RATING)



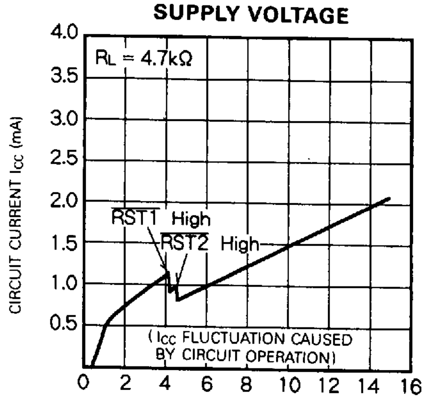
DETECT VOLTAGE VS. SUPPLY VOLTAGE



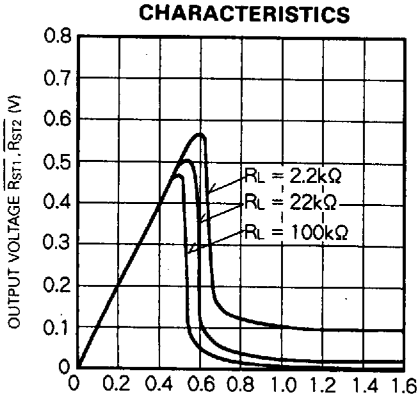
CIRCUIT CURRENT VS. SUPPLY VOLTAGE



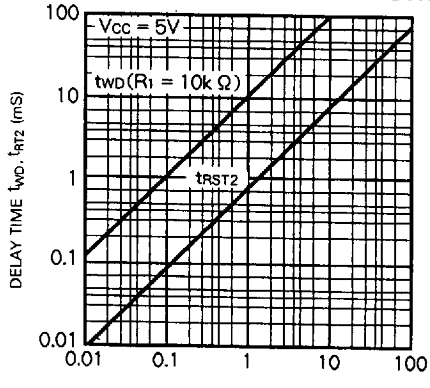
CIRCUIT CURRENT VS. SUPPLY VOLTAGE



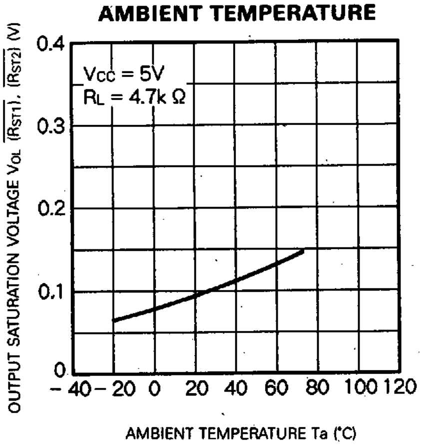
CRITICAL OPERATION VOLTAGE CHARACTERISTICS



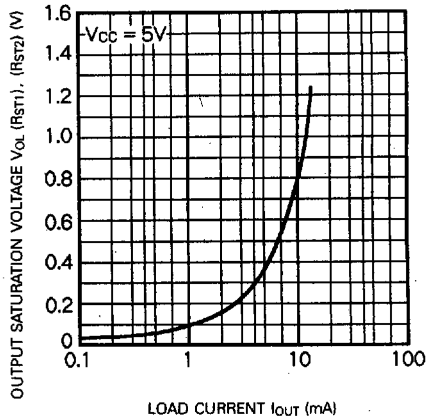
DELAY TIME VS. DELAY CAPACITY CHARACTERISTICS



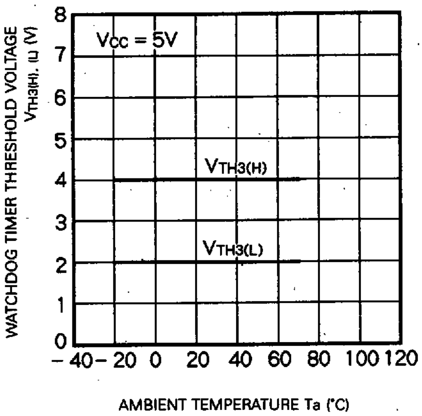
OUTPUT SATURATION VOLTAGE VS. AMBIENT TEMPERATURE



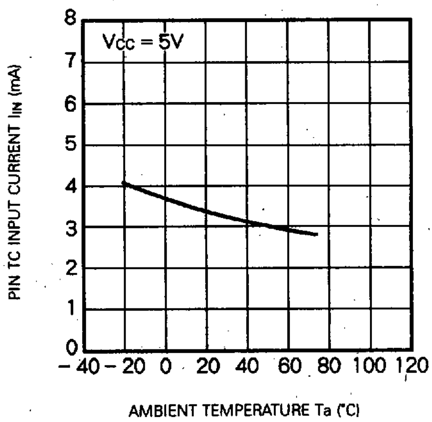
OUTPUT SATURATION VOLTAGE VS. LOAD CURRENT



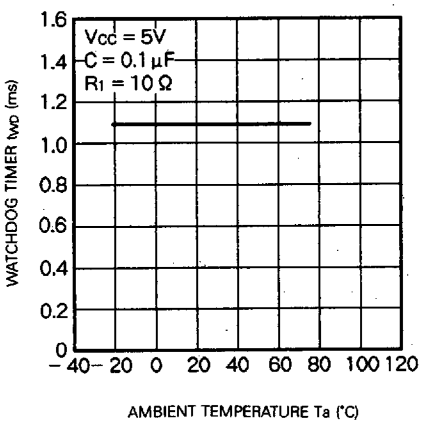
WATCHDOG TIMER THRESHOLD VOLTAGE VS. AMBIENT TEMPERATURE



PIN TC INPUT CURRENT VS. AMBIENT TEMPERATURE



WATCHDOG TIMER VS. AMBIENT TEMPERATURE



RESET TIMER (2) VS. AMBIENT TEMPERATURE