

## ASSP

# Power Supply Monitor with Watch-Dog Timer

## MB3773

### ■ DESCRIPTION

The Fujitsu MB3773 is designed to monitor the voltage level of a power supply (+5V or an arbitrary voltage) in a microprocessor circuit, memory board in a large-size computer, for example. The MB3773 also contains a watch-dog timer function to detect uncontrol. Table status of processor and reset system/processor.

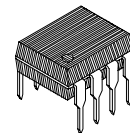
If the circuit's power supply deviates more than a specified amount, then the MB3773 generates a reset signal to the microprocessor. Thus, the computer data is protected from accidental erasure.

When the MB3773 does not receive the clock pulse from the processor in the specified period, the MB3773 generates a reset signal to the microprocessor.

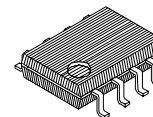
Using the MB3773 requires few external components. To monitor only a +5 volt supply, the MB3773 requires the connection of one external capacitor.

The MB3773 is available in an 8-pin Dual In-Line package space saving Flat Package, or a Single In-Line Package.

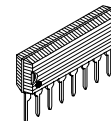
- Precision voltage detection ( $V_s = 4.2V \pm 2.5\%$ )
- Threshold level with hysteresis
- Low voltage output for reset signal ( $V_{cc} = 0.8V$  typ.)
- Precision reference voltage output ( $V_{REF} = 1.245V \pm 1.5\%$ )
- External clock monitor and reset signal generator
- Negative-edge input watch-dog timer
- Minimal number of external components (one capacitor min.)
- Available in a variety of packages
  - 8-pin Dual In-Line Package
  - 8-pin Flat Package
  - 8-pin Single In-Line Package



PLASTIC PACKAGE  
DIP-8P-M01



PLASTIC PACKAGE  
FPT-8P-M01

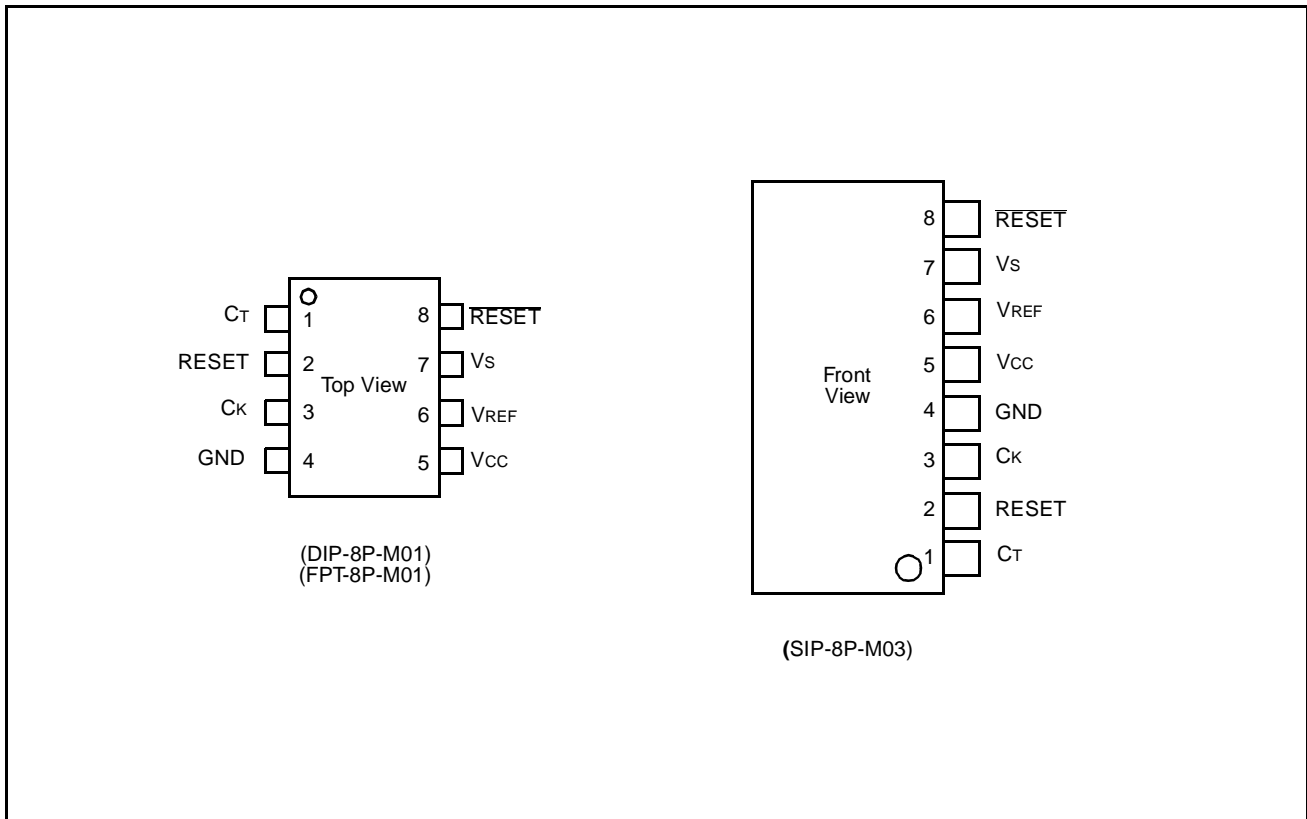


PLASTIC PACKAGE  
SIP-8P-M03

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields. However, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit.

# MB3773

## ■ PIN ASSIGNMENT

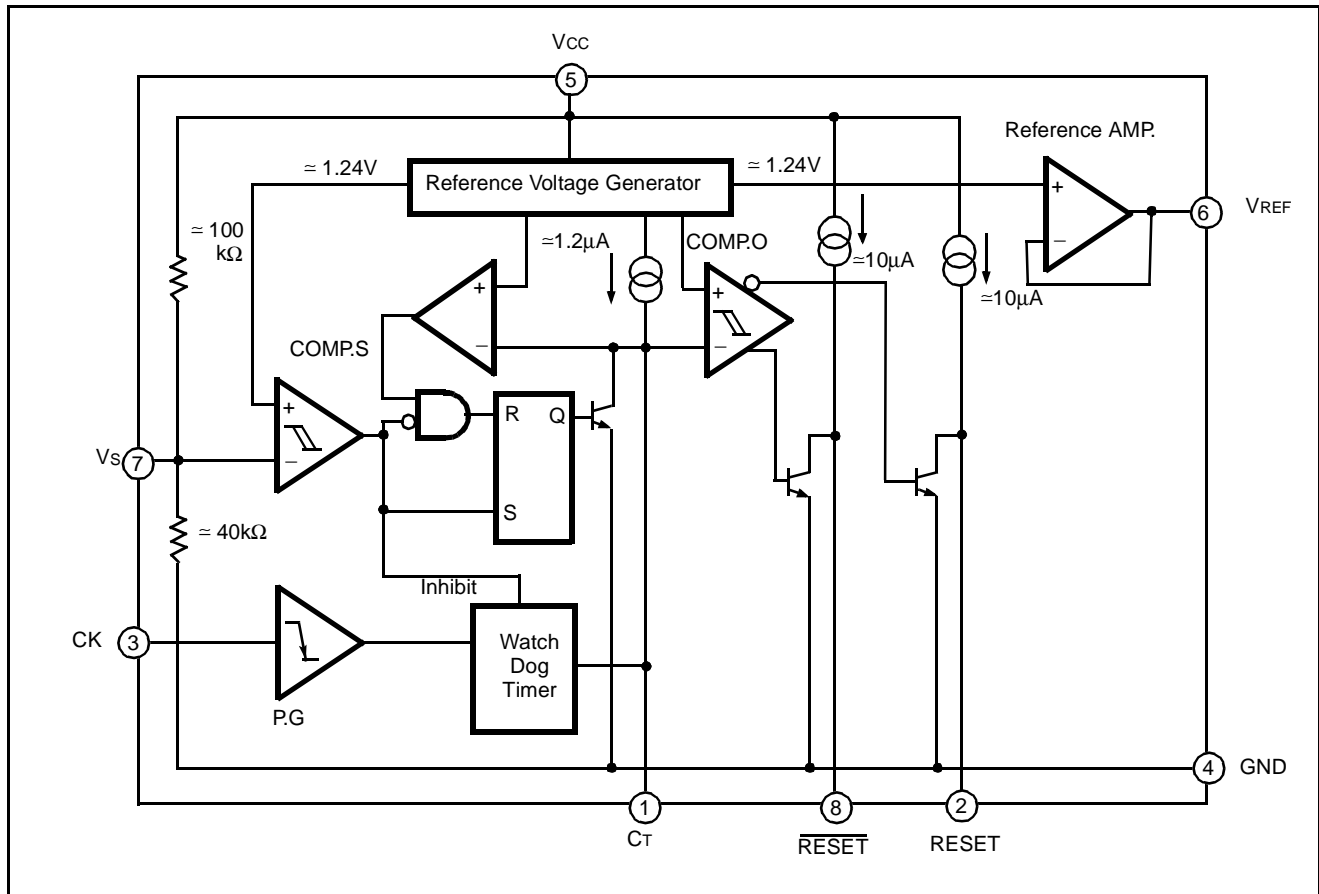


## ■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit
Supply voltage	V <sub>CC</sub>	-0.3 to +18	V
Input voltage	V <sub>S</sub>	-0.3 to V <sub>CC</sub> +0.3 (≤+18)	V
	V <sub>S</sub>	-0.3 to +18	V
RESET, RESET Supply voltage	V <sub>OH</sub>	-0.3 to V <sub>CC</sub> +0.3 (≤+18)	V
Power dissipation (T <sub>a</sub> ≤ 85°C)	P <sub>D</sub>	200	mW
Storage temperature	T <sub>STG</sub>	-55 to +125	°C

**NOTE:** Permanent device damage may occur if the above **Absolute Maximum Ratings** are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

■ BLOCK DIAGRAM



■ RECOMMENDED OPERATING CONDITIONS



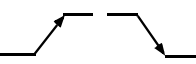
Parameter	Symbol	Value	Unit
Supply voltage	VCC	+3.5 to +16	V
Reset, reset sink current	IOL	0 to 20	mA
VREF output current	IOUT	-200 to +5	μA
Watch clock setting time	tWD	0.1 to 1000	ms
Rising/falling time	tFC, tRC	<100	μs
Terminal capacitance	CT	0.001 to 10	μF
Operating ambient temperature	Ta	-40 to +85	°C

# MB3773

## ■ ELECTRICAL CHARACTERISTICS

### (1) DC Characteristics

(V<sub>CC</sub>=5V, T<sub>a</sub>=25°C)

Parameter	Condition	Symbol	Value			Unit
			Min	Typ	Max	
Supply current	Watch dog timer operating	I <sub>CC</sub>	-	600	900	μA
Detection voltage	V <sub>CC</sub> 	V <sub>SL</sub>	4.10	4.20	4.30	V
	T <sub>a</sub> = -40°C to +85°C		4.05	4.20	4.35	
	V <sub>CC</sub> 	V <sub>SH</sub>	4.20	4.30	4.40	
	T <sub>a</sub> = -40°C to +85°C		4.15	4.30	4.45	
Hysteresis width	V <sub>CC</sub> 	V <sub>HYS</sub>	50	100	150	mV
Reference voltage	-	V <sub>REF</sub>	1.227	1.245	1.263	V
	T <sub>a</sub> = -40°C to +85°C		1.215	1.245	1.275	
Reference voltage change rate	V <sub>CC</sub> = 3.5 to 16V	ΔV <sub>REF1</sub>	-	3	10	mV
Reference voltage output loading change rate	I <sub>OUT</sub> = -200μA to +5μA	ΔV <sub>REF2</sub>	-5	-	+5	mV
CK threshold voltage	T <sub>a</sub> = -40°C to +85°C	V <sub>TH</sub>	0.8	1.25	2.0	V
CK input current	V <sub>CK</sub> = 5.0V	I <sub>IH</sub>	-	0	1.0	μA
	V <sub>CK</sub> = 0.0V	I <sub>IL</sub>	-1.0	-0.1	-	
CK input current	Watch dog timer operating V <sub>CT</sub> = 1.0V	I <sub>CTD</sub>	7	10	14	μA
High level output voltage	V <sub>S</sub> open, I <sub>RESET</sub> = -5μA	V <sub>OH1</sub>	4.5	4.9	-	V
	V <sub>S</sub> = 0V, I <sub>RESET</sub> = -5μA	V <sub>OH2</sub>	4.5	4.9	-	
Output saturation voltage	V <sub>S</sub> = 0V, I <sub>RESET</sub> = 3mA	V <sub>OL1</sub>	-	0.2	0.4	V
	V <sub>S</sub> = 0V, I <sub>RESET</sub> = 10mA	V <sub>OL2</sub>	-	0.3	0.5	
	V <sub>S</sub> open, I <sub>RESET</sub> = 3mA	V <sub>OL3</sub>	-	0.2	0.4	
	V <sub>S</sub> open, I <sub>RESET</sub> = 10mA	V <sub>OL4</sub>	-	0.3	0.5	
Output sink current	V <sub>S</sub> = 0V, V <sub>RESET</sub> = 1.0V	I <sub>OL1</sub>	20	60	-	mA
	V <sub>S</sub> open, V <sub>RESET</sub> = 1.0V	I <sub>OL2</sub>	20	60	-	

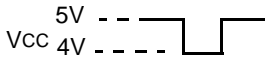
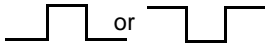

## (1) DC Characteristics (Continued)

(V<sub>CC</sub>=5V, T<sub>a</sub>=25°C)

Parameter	Condition	Symbol	Value			Unit
			Min	Typ	Max	
CT charge current	Power on reset operating V <sub>CT</sub> = 1.0V	I <sub>CTU</sub>	0.5	1.2	2.5	μA
Min. supply voltage for <b>RESET</b>	V <sub>RESET</sub> = 0.4V I <sub>RESET</sub> = 0.2mA	V <sub>CC1</sub>	-	0.8	1.2	V
Min. supply voltage for <b>RESET</b>	V <sub>RESET</sub> = V <sub>CC</sub> - 0.1V R <sub>L</sub> (2 pin - GND) = 1MΩ	V <sub>CC2</sub>	-	0.8	1.2	V

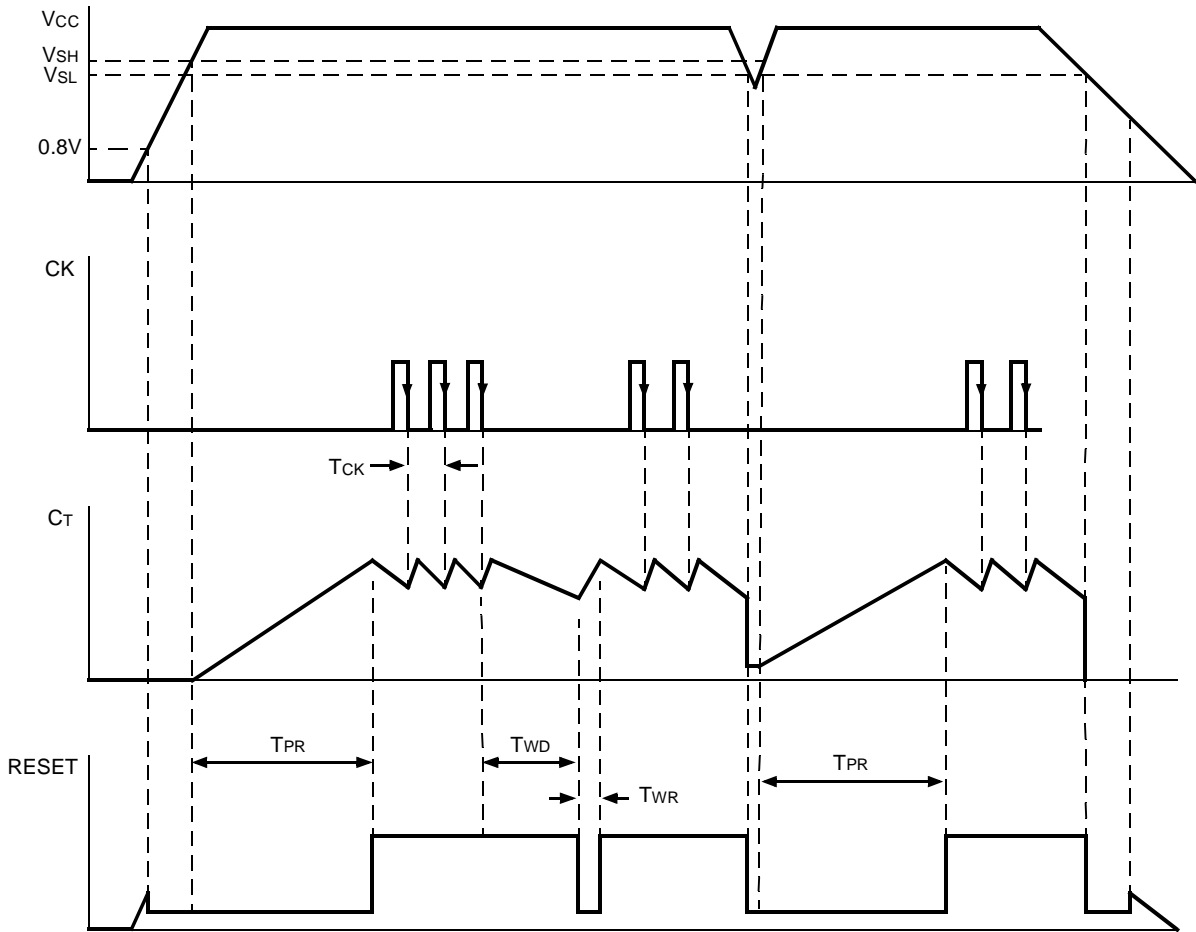
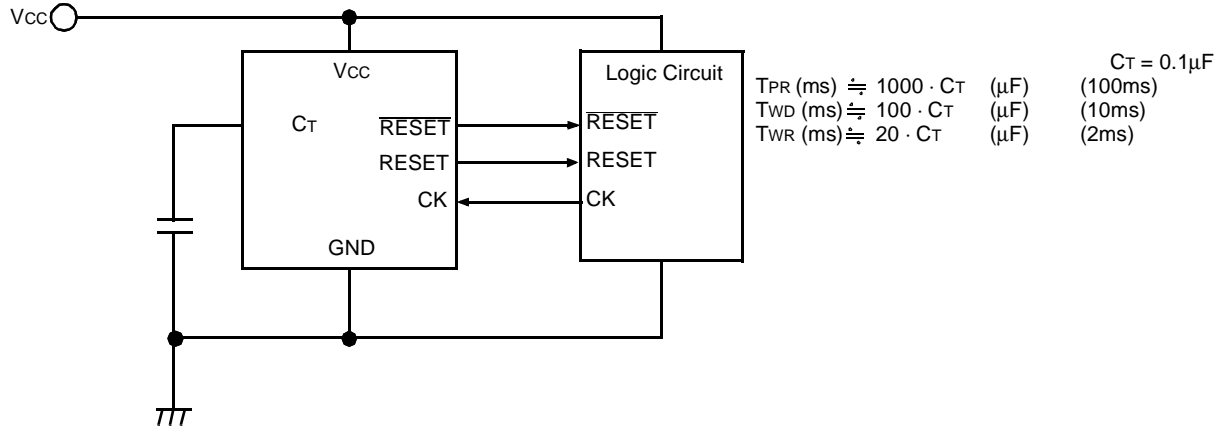
## (2) AC Characteristics

(V<sub>CC</sub>=5V, T<sub>a</sub>=25°C)

Parameter	Condition	Symbol	Value			Unit
			Min	Typ	Max	
V <sub>CC</sub> input pulse width		T <sub>PI</sub>	8.0	-	-	μs
CK input pulse width		T <sub>CKW</sub>	3.0	-	-	μs
CK input frequency		T <sub>CK</sub>	20	-	-	μs
Watch dog timer watching time	C <sub>T</sub> = 0.1μF	T <sub>WD</sub>	5	10	15	ms
Watch dog timer reset time	C <sub>T</sub> = 0.1μF	T <sub>WR</sub>	1	2	3	ms
Rising reset hold time	C <sub>T</sub> = 0.1μF, V <sub>CC</sub> 	T <sub>PR</sub>	50	100	150	ms
Output propagation Delay time from V <sub>CC</sub>	$\overline{\text{RESET}}$ , R <sub>L</sub> = 2.2kΩ C <sub>L</sub> = 100pF	T <sub>PD1</sub>	-	2	10	μs
	$\overline{\text{RESET}}$ , R <sub>L</sub> = 2.2kΩ C <sub>L</sub> = 100pF	T <sub>PD2</sub>	-	3	10	
Output rising time *	R <sub>L</sub> = 2.2kΩ C <sub>L</sub> = 100pF	t <sub>R</sub>	-	1.0	1.5	μs
Output falling time *	R <sub>L</sub> = 2.2kΩ C <sub>L</sub> = 100pF	t <sub>F</sub>	-	0.1	0.5	

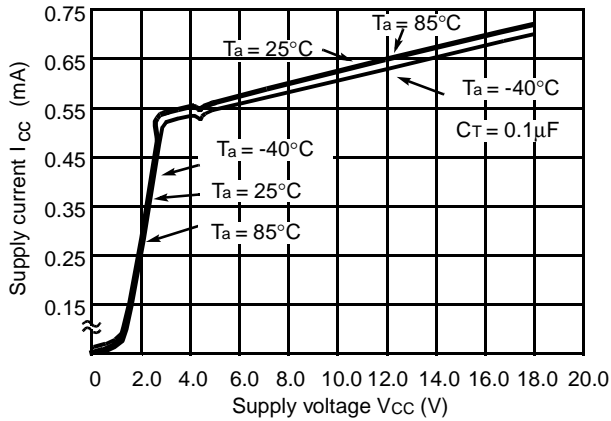
\* Output rising/falling time are measured at 10% to 90% of voltage.

Fig. 1 - MB3773 Basic Operation

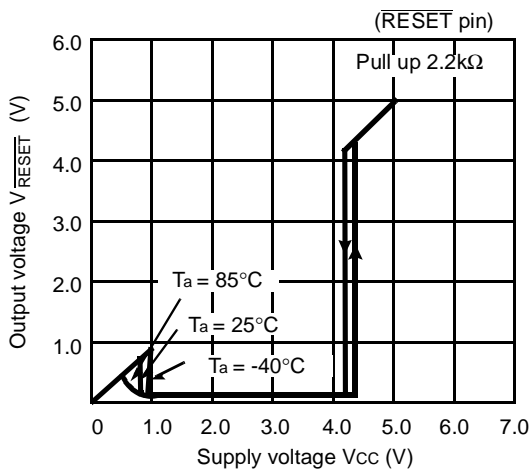


## TYPICAL CHARACTERISTIC CURVES

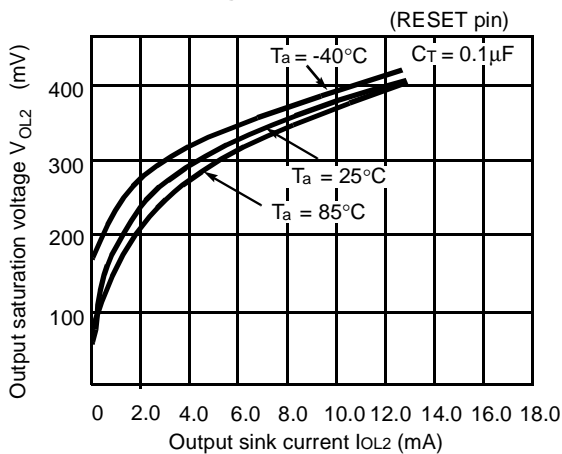
**Fig. 2 - Supply current vs. supply voltage**



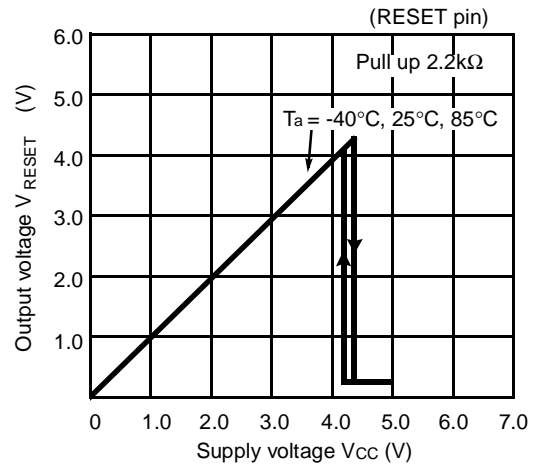
**Fig. 4 - Output voltage vs. supply voltage**



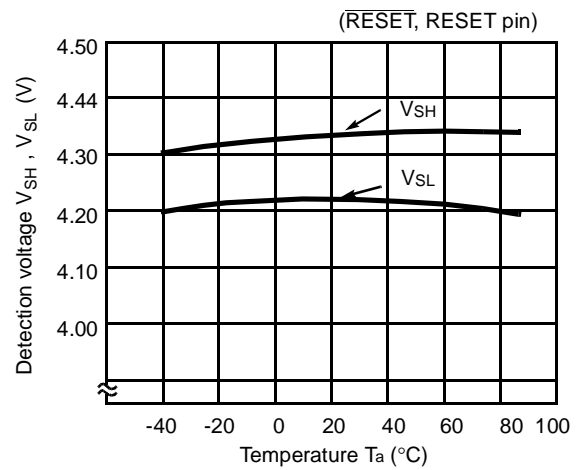
**Fig. 6 - Output saturation voltage vs. output sink current**



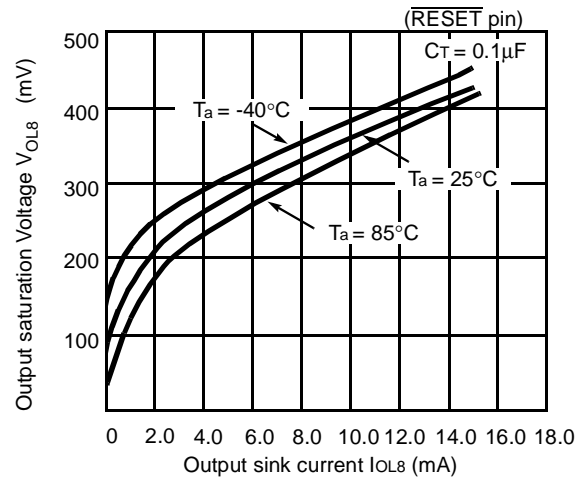
**Fig. 3 - Output voltage vs. supply voltage**



**Fig. 5 - Detection voltage (V\_SH, V\_SL) vs. temperature**

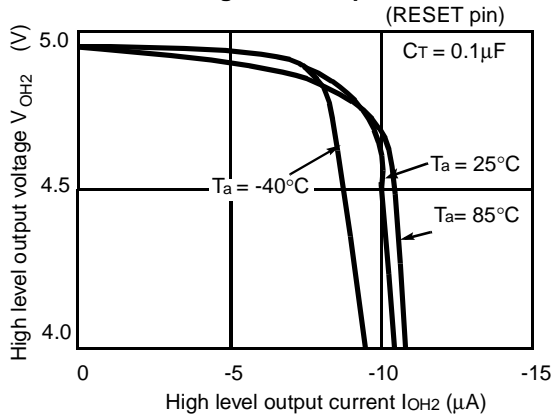


**Fig. 7 - Output saturation voltage vs. output sink current**

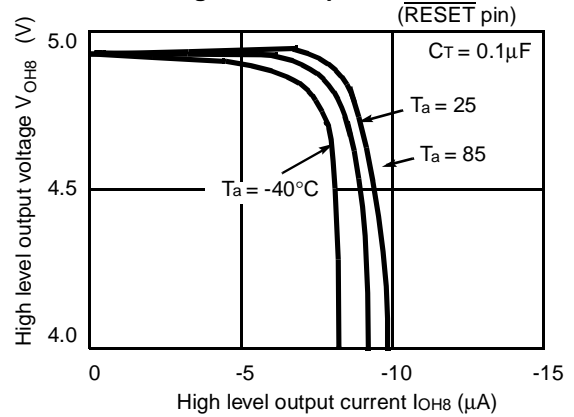


## ■ TYPICAL CHARACTERISTIC CURVES (Continued)

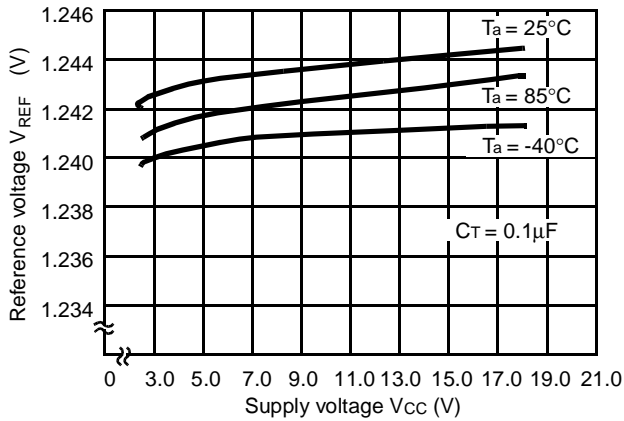
**Fig. 8 - High level output voltage vs. high level output current**



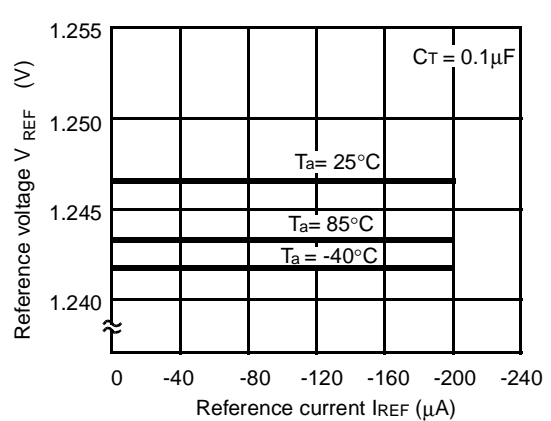
**Fig. 9 - High level output voltage vs. high level output current**



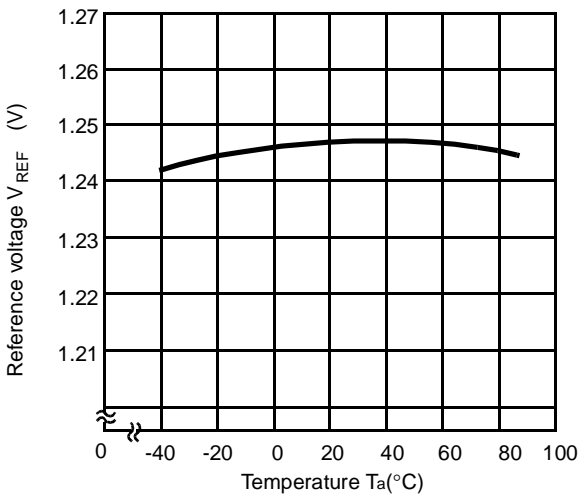
**Fig. 10 - Reference voltage vs. supply voltage**



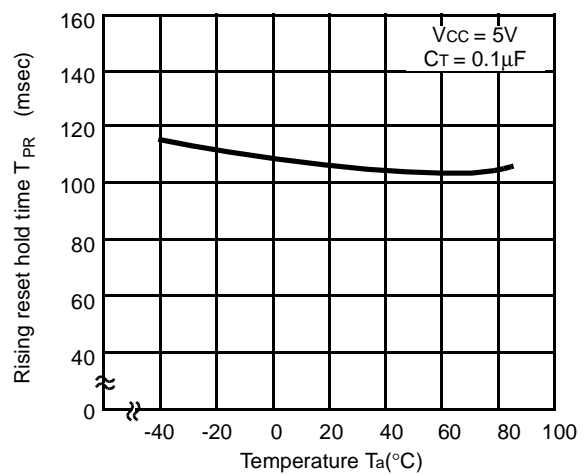
**Fig. 11 - Reference voltage vs. reference current**



**Fig. 12 - Reference voltage vs. temperature**



**Fig. 13 - Rising reset hold time vs. temperature**





■ TYPICAL CHARACTERISTIC CURVES (Continued)

Fig. 14 - Reset time vs. temperature

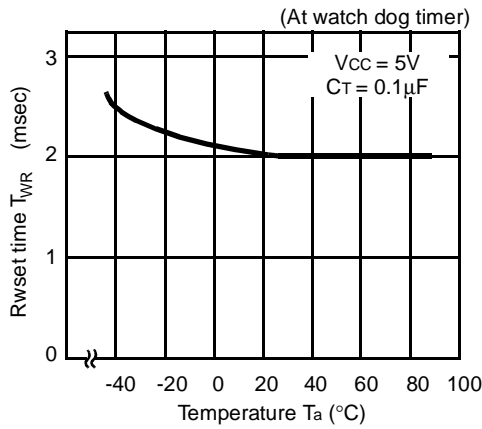


Fig. 15 - Watch dog timer watching time vs. temperature

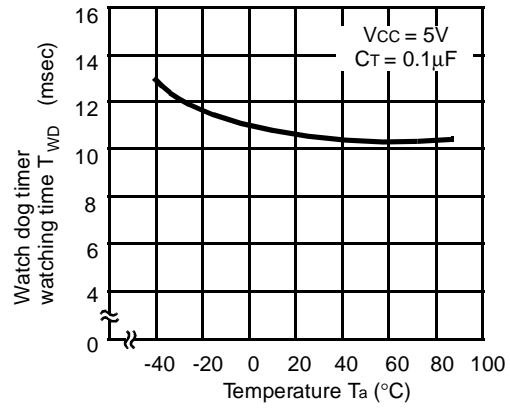


Fig. 16 - Terminal capacitance vs. rising reset hold time

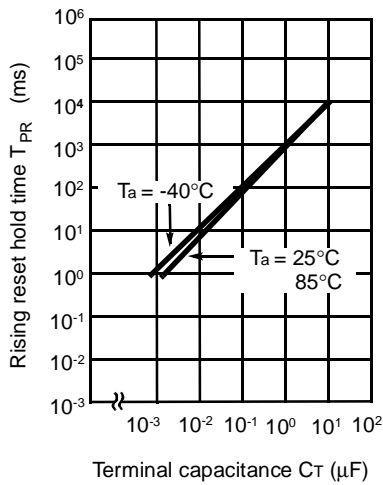


Fig. 17 - Terminal capacitance vs. reset time

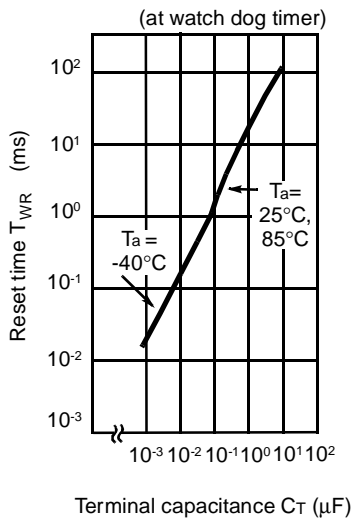
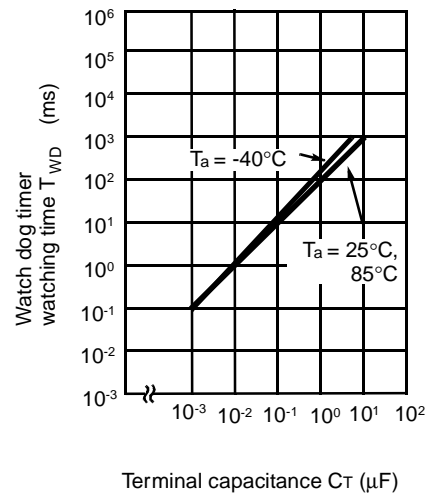
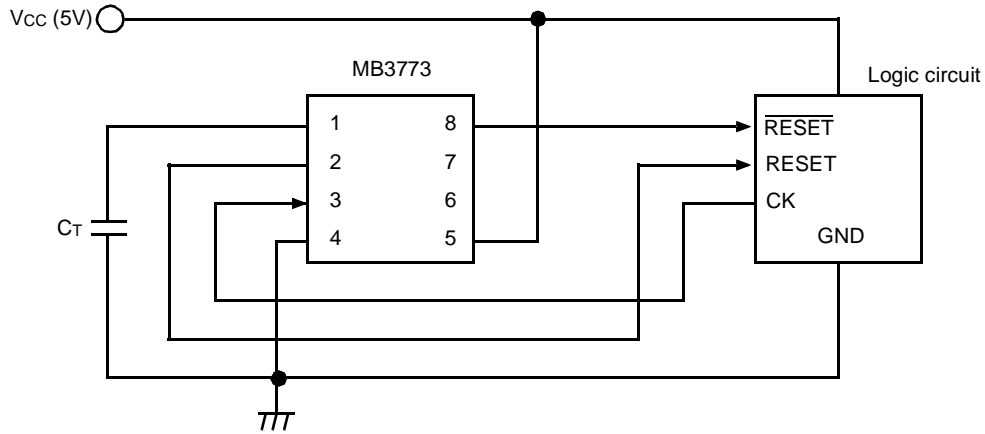


Fig. 18 - Terminal capacitance vs. watch dog timer watching time



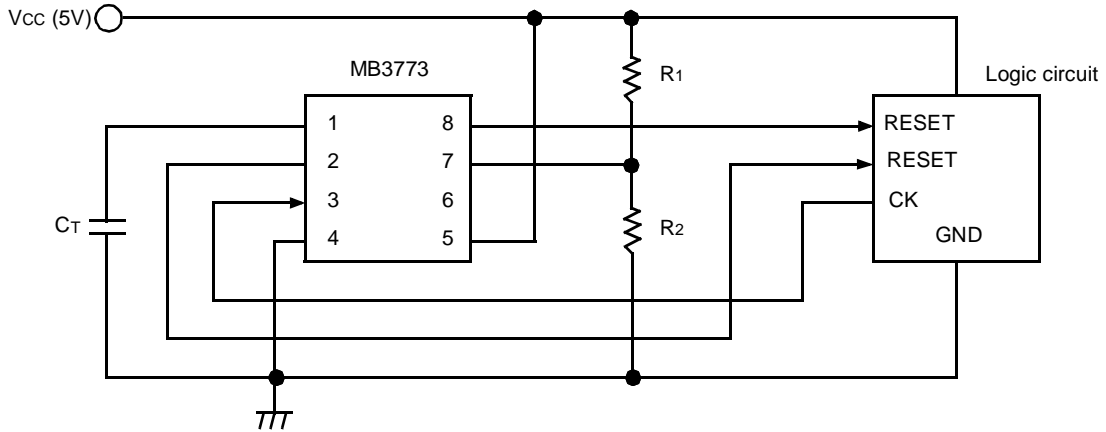
## ■ APPLICATION CIRCUIT

**EXAMPLE 1 : Monitoring 5V Supply Voltage and Watch-dog Timer**



- Supply voltage is monitored using V<sub>s</sub>.  
Detection voltage are V<sub>SH</sub> and V<sub>SL</sub>.

**EXAMPLE 2 : 5V Supply Voltage Monitoring (external fine-tuning type)**

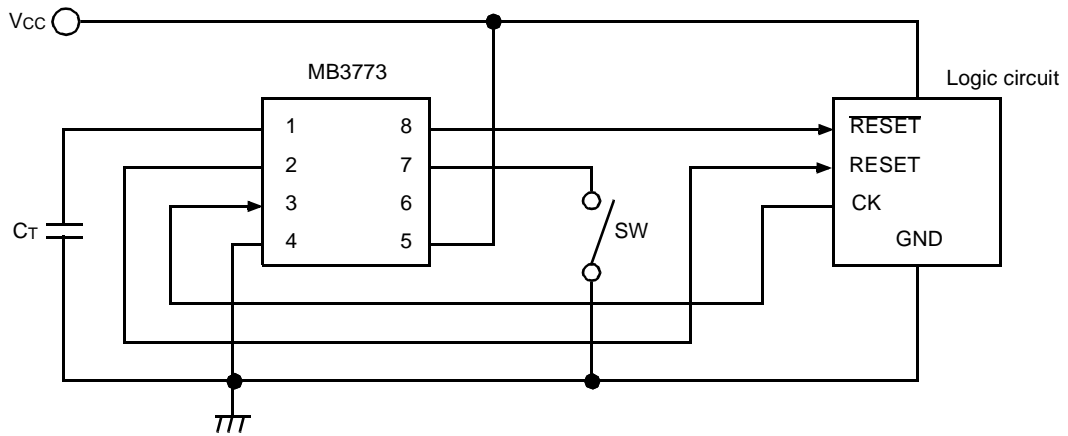


- V<sub>s</sub> detection voltage can be adjusted externally.
- Selecting R<sub>1</sub> and R<sub>2</sub> values that are sufficiently lower than the resistance of the IC's internal voltage divider allows the detection voltage to be set according to the resistance ratio between R<sub>1</sub> and R<sub>2</sub>. (See the table below.)

R <sub>1</sub> (kΩ)	R <sub>2</sub> (kΩ)	Detection voltage:V <sub>SL</sub> (V)	Detection voltage:V <sub>SH</sub> (V)
10	3.9	4.4	4.5
9.1	3.9	4.1	4.2

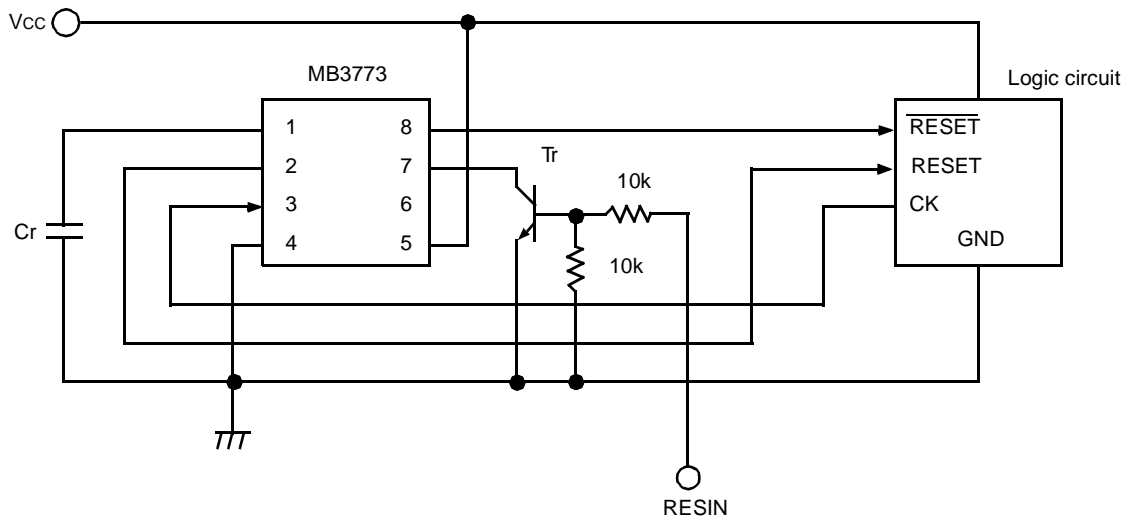
EXAMPLE 3 : With Forced Reset (with reset hold)

a



- Grounding pin 7 at the time of SW ON sets RESET (pin 8) to Low and RESET (pin 2) to High.

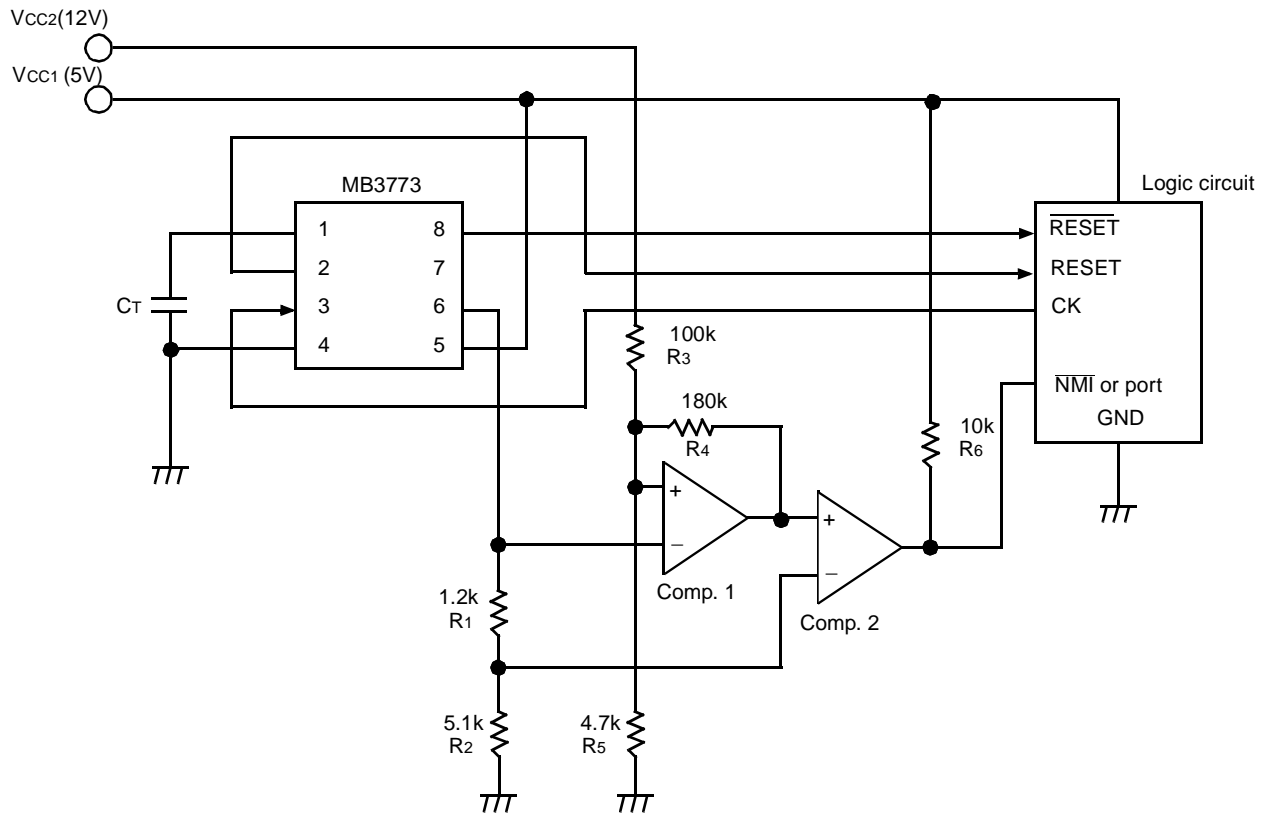
b



- Feeding the signal to pin RESIN and turning on  $Tr$  sets the RESET pin to Low and the RESET pin to High.

# MB3773

## EXAMPLE 4 : Monitoring Two Supply Voltages (with hysteresis, reset output and NMI)



Example : Comp. 1, Comp. 2  
: MB4204, MB47393

**NOTE:** The 5V supply voltage is monitored by the MB3773. The 12V supply voltage is monitored by the external circuit. Its output is connected to the  $\overline{\text{NMI}}$  pin and, when voltage drops, Comp. 2 interrupts the logic circuit.

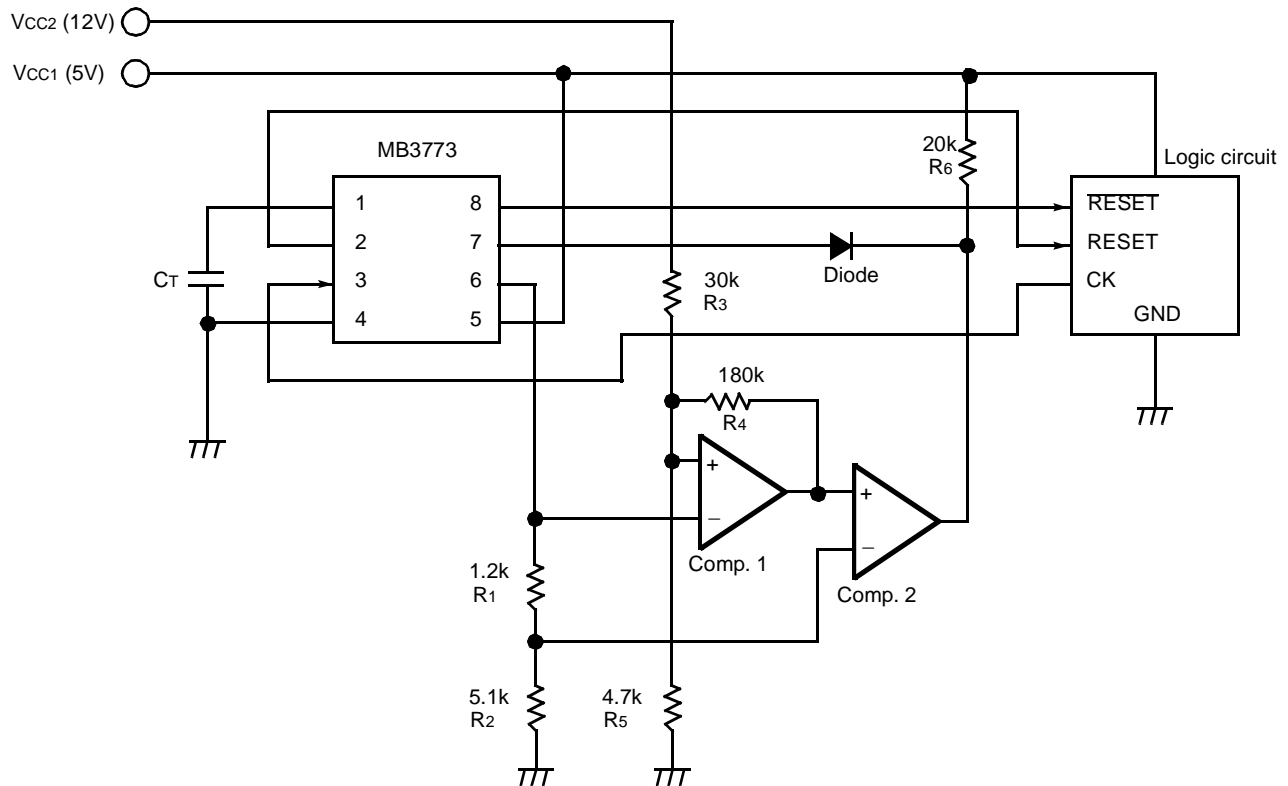
- Use VCC1 (=5V) to power the comparators (Comp. 1 and Comp. 2) in the external circuit shown above.
- The detection voltage of the VCC2 (=12V) supply voltage is approximately 0.2V. VCC2 detection voltage and hysteresis width can be found using the following formulas:

$$\rightarrow \text{Detection voltage } V_{2H} = \frac{R_3 + (R_4 // R_5)}{R_4 // R_5} \times V_{REF} \quad (\text{Approx. } 9.4\text{V in the above illustration})$$

$$V_{2L} = \frac{R_3 + R_5}{R_5} \times V_{REF} \quad (\text{Approx. } 9.2\text{V in the above illustration})$$

$$\rightarrow \text{Hysteresis width } V_{HYS} = V_{2H} - V_{2L}$$

## EXAMPLE 5 : Monitoring Two (M) Supply Voltages (with hysteresis and reset output)

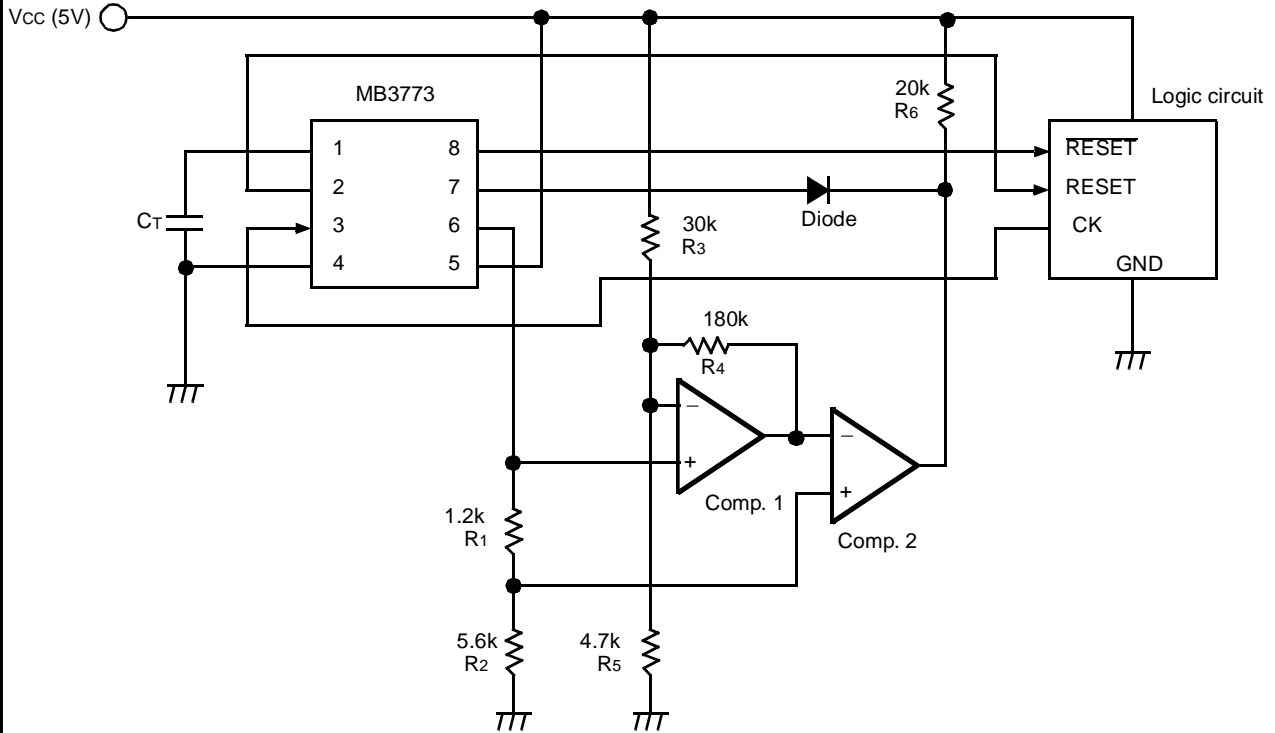


Example : Comp. 1, Comp. 2  
: MB4204, MB47393

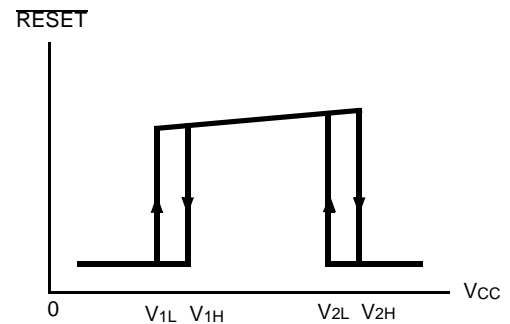
**NOTE:** When either 5V or 12V supply voltage decreases below its detection voltage ( $V_{SL}$ ), the MB3773 RESET pin is set to High and the MB3773 RESET pin is set to Low.

- Use VCC1 (=5V) to power the comparators (Comp. 1 and Comp. 2) in the external circuit shown above.
- The detection voltage of the VCC2 (=12V) supply voltage is approximately 9.2V/9.4V and has a hysteresis width of approximately 0.2V.  
For the formulas for finding hysteresis width and detection voltage, see section 4.

## EXAMPLE 6 : Monitoring Low voltage and Overvoltage Monitoring (with hysteresis)

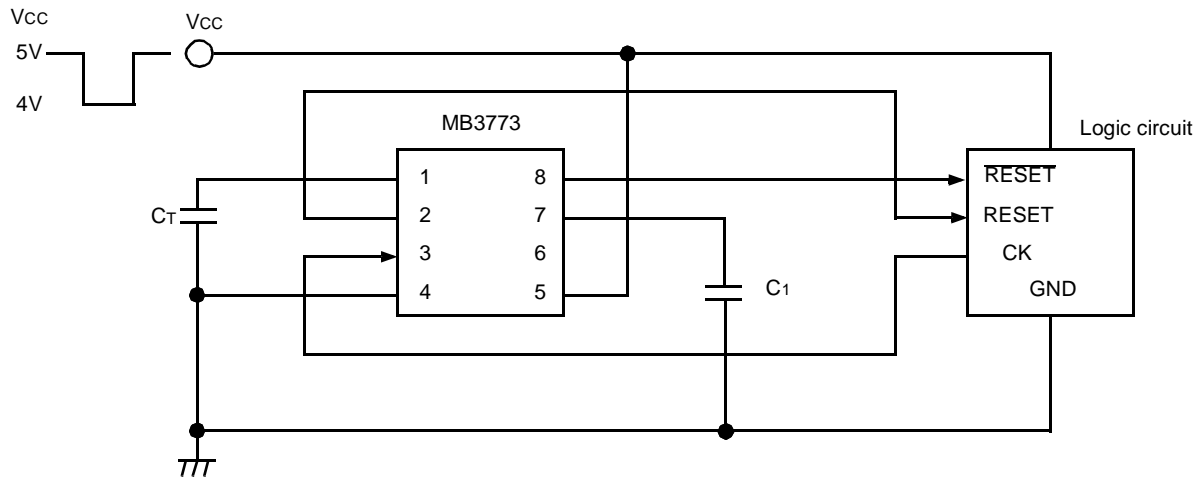


Example : Comp. 1, Comp. 2  
: MB4204, MB47393



- Comp. 1 and Comp. 2 are used to monitor for overvoltage while the MB3773 is used to monitor for low voltage.  
Detection voltages  $V1/V1H$  at the time of low voltage are approximately 4.2V/4.3V. Detection voltages  $V2L/V2H$  at the time of overvoltage are approximately 6.0V/6.1V.  
For the formulas for finding hysteresis width and detection voltage, see section 4.
- Use VCC (=5V) to power the comparators (Comp. 1 and Comp. 2) in the external circuit shown above.

EXAMPLE 7 : Monitoring Supply Voltage Using Delayed Trigger



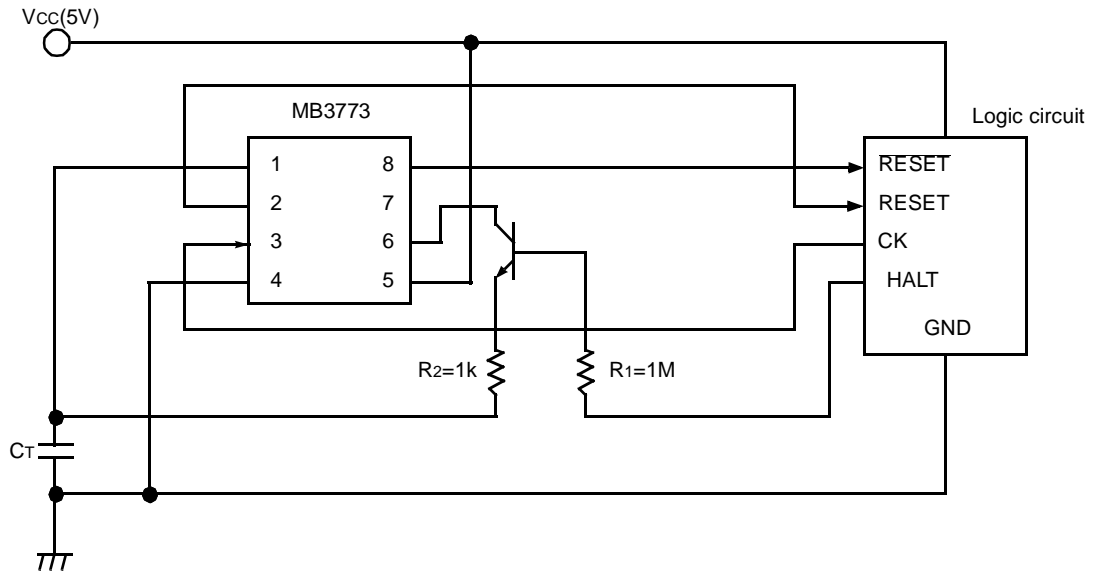
- Adding voltage such as shown in the figure to VCC increases the minimum input pulse width by 50 microseconds (C<sub>1</sub> = 1000pF).

## EXAMPLE 8 : Stopping Watch-dog Timer (Monitoring only supply voltage)

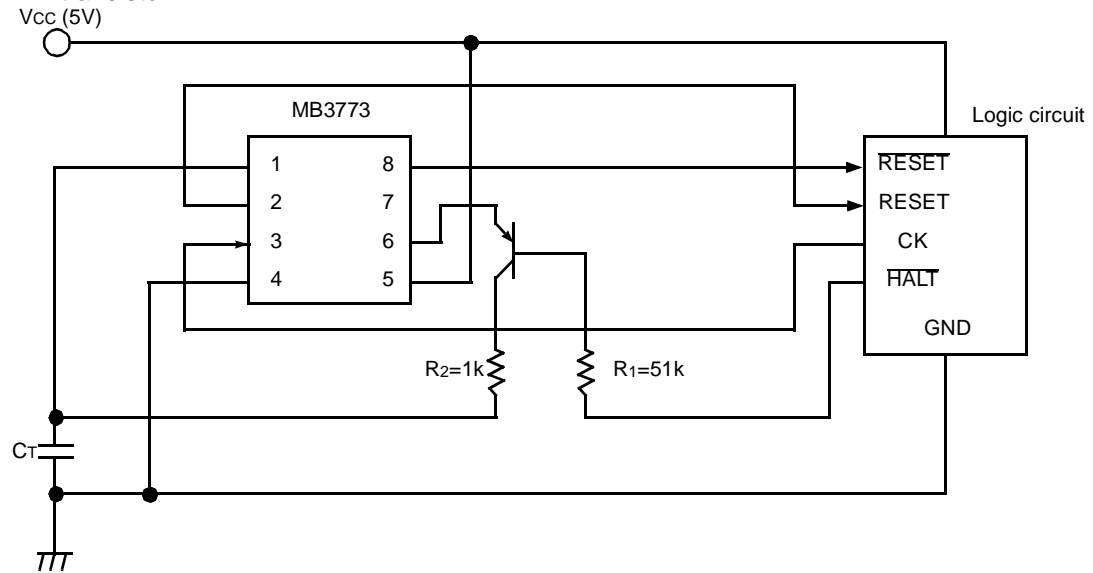
These are example application circuits in which the MB3773 monitors supply voltage alone without resetting the microcomputer even if the latter, used in standby mode, stops sending the clock pulse to the MB3773.

- The watch-dog timer is inhibited by clamping the Cr pin voltage to VREF .  
The supply voltage is constantly monitored even while the watch-dog timer is inhibited.  
For this reason, a reset signal is output at the occurrence of either instantaneous disruption or a sudden drop to low voltage.  
Note that in application examples a and b, the hold signal is inactive when the watch-dog timer is inhibited at the time of resetting.  
If the hold signal is active when the microcomputer is reset, the solution is to add a gate, as in examples c and d.

a Using NPN transistor



b Using PNP transistor

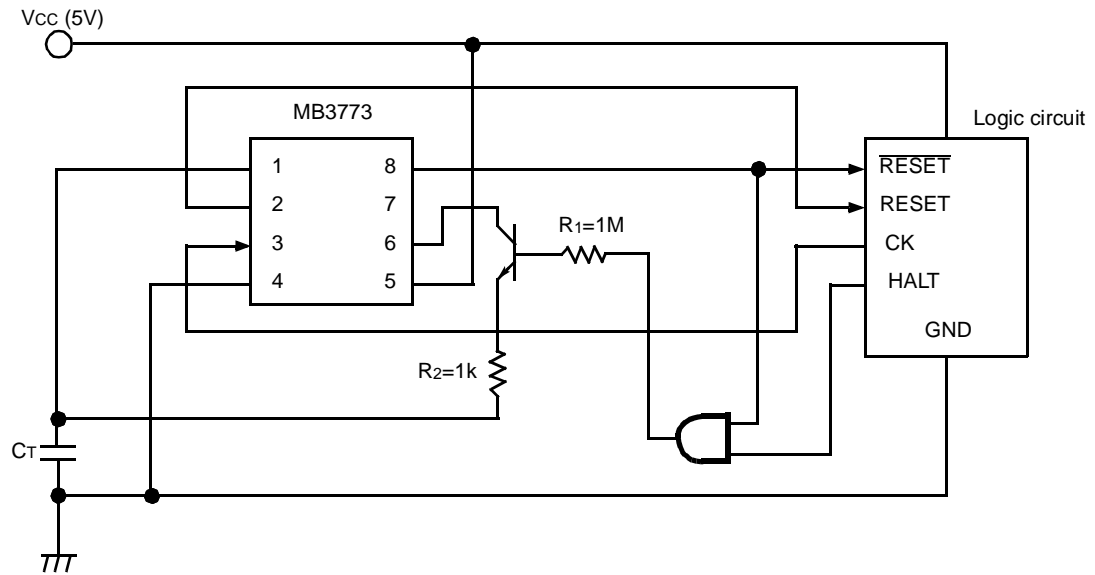


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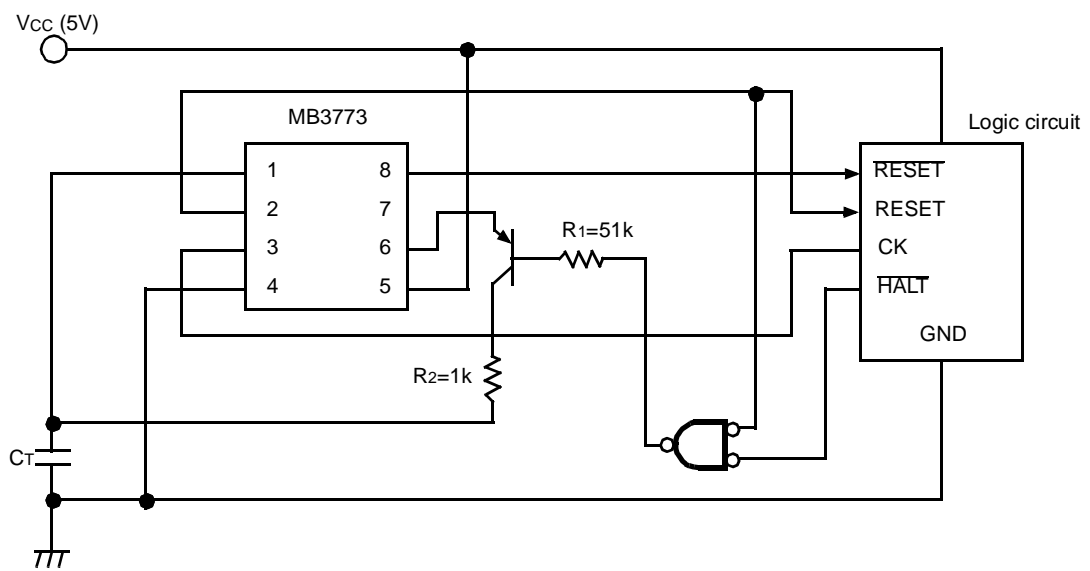


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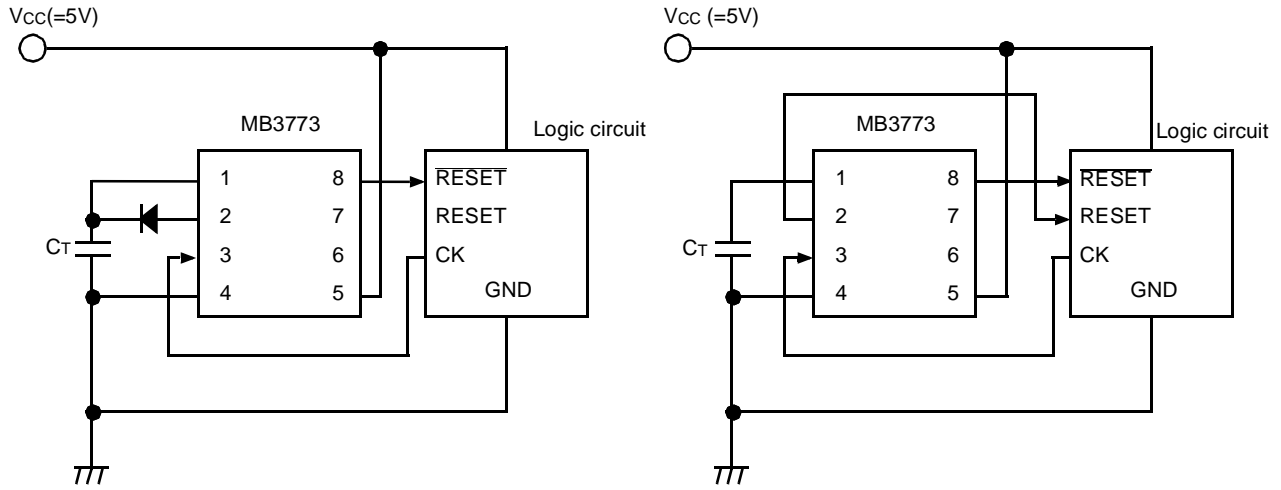
c Using NPN transistor



d Using PNP transistor



## EXAMPLE 9 : Reducing Reset Hold Time



(a) TPR reduction method

(b) Standard usage

- **RESET** is the only output that can be used.
- Standard TPR, TWD and TWR value can be found using the following formulas.

Formulas :

$$TPR (ms) \simeq 100 \times CT (\mu F)$$

$$TWD (ms) \simeq 100 \times CT (\mu F)$$

$$TWR (ms) \simeq 16 \times CT (\mu F)$$

- The above formulas allow for standard values in determining TPR, TWD and TWR.  
Reset hold time is compared below between the reduction circuit and the standard circuit.

$CT = 0.1\mu F$

	TPR reduction circuit	Standard circuit
TPR $\simeq$	10ms	100ms
TWD $\simeq$	10ms	10ms
TWR $\simeq$	1.6ms	2.0ms

EXAMPLE 10 : Circuit for Monitoring Multiple Microcomputers

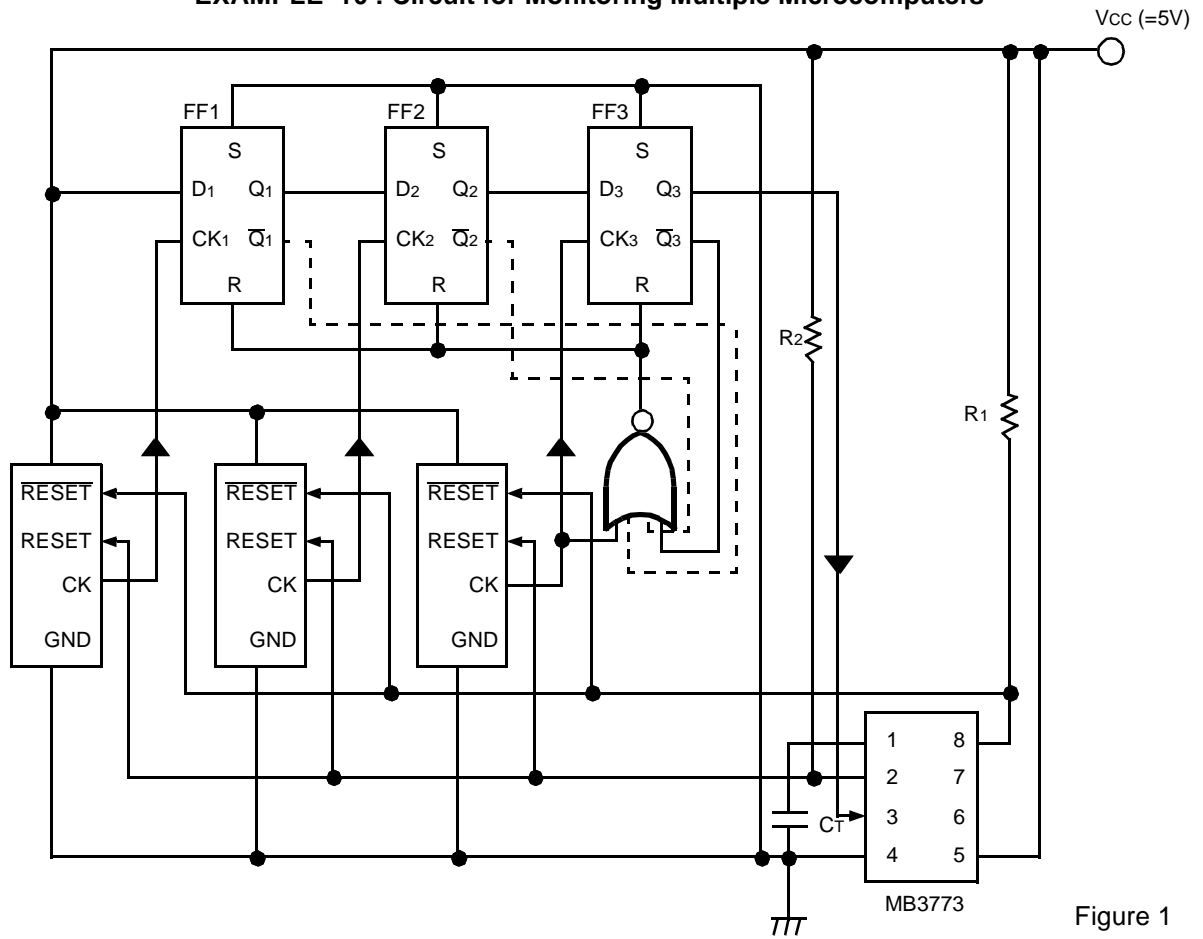


Figure 1

- - - - - connects from FF1 and FF2 outputs Q1 and Q2 to the NOR input.  
Depending on timing, these connections may not be necessary.  
Example:  $R1 = R2 = 2.2k\Omega$   
 $CT = 0.1\mu F$

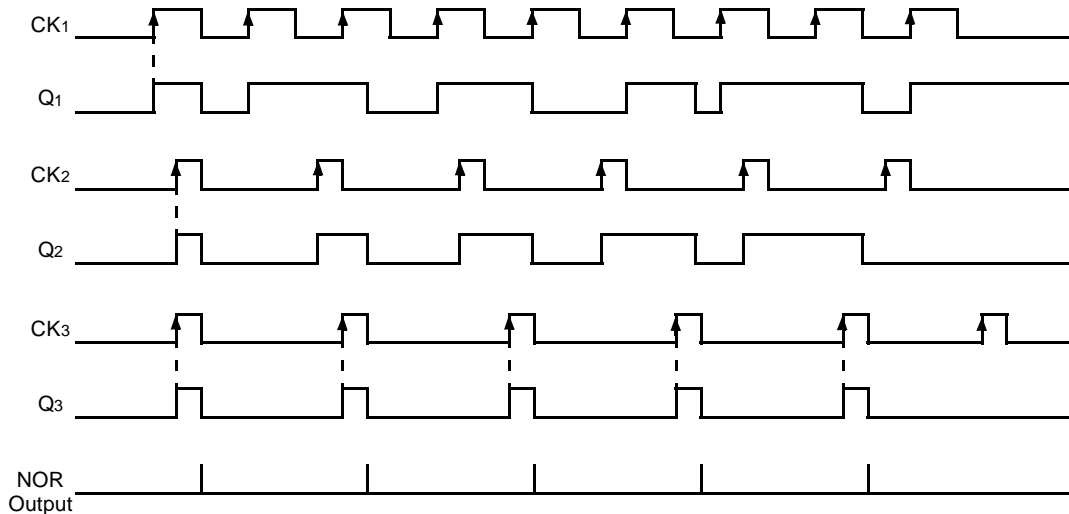


Figure 2

# MB3773

## Description of Application Circuits

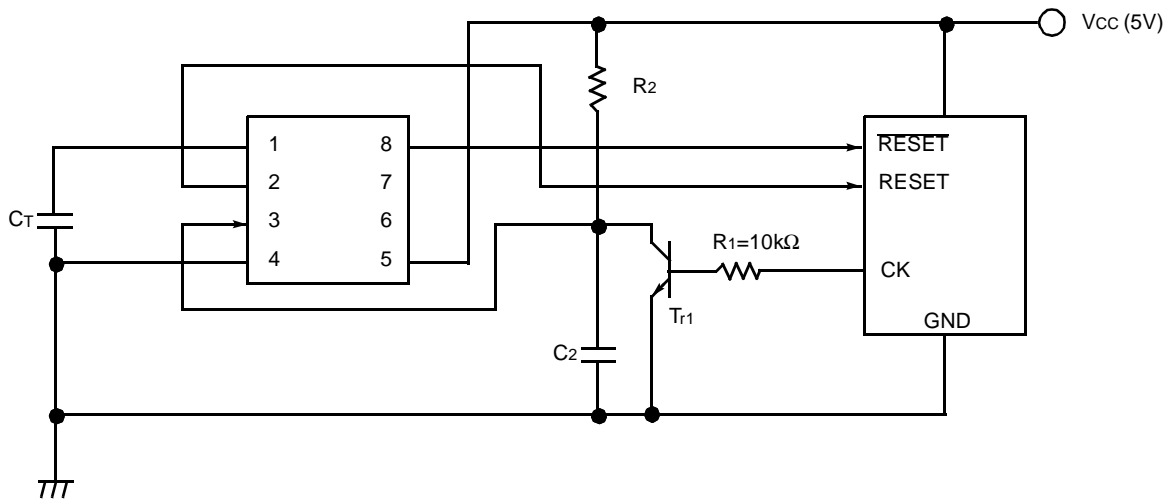
Using one MB3773, this application circuit monitors multiple microcomputers in one system. Signals from each microcomputer are sent to FF1, FF2 and FF3 clock inputs. Figure 2 shows these timings. Each flip-flop operates using signals sent from microcomputers as its clock pulse. When even one signal stops, the relevant receiving flip-flop stops operating. As a result, cyclical pulses are not generated at output Q3. Since the clock pulse stops arriving at the CK pin of the MB3773, the MB3773 generates a reset signal.

Note that output Q3 frequency  $f$  will be in the following range, where the clock frequencies of CK1, CK2 and CK3 are  $f_1$ ,  $f_2$  and  $f_3$  respectively.

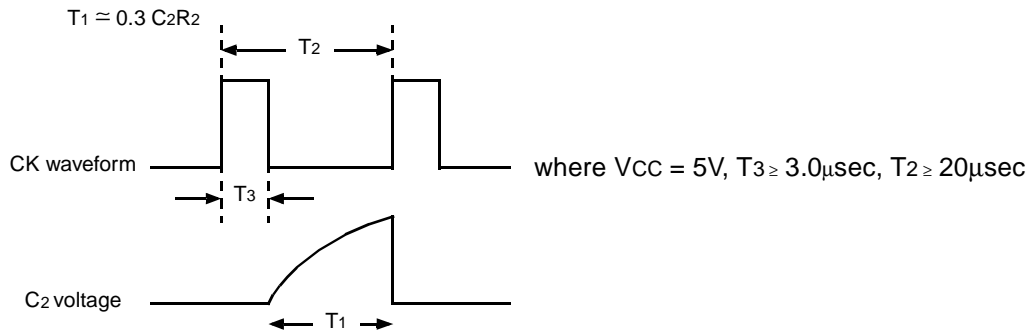
$$\Rightarrow \frac{1}{f_0} \leq \frac{1}{f} \leq \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$$

where  $f_0$  is the lowest frequency among  $f_1$ ,  $f_2$  and  $f_3$ .

**EXAMPLE 11 : Circuit for Limiting Upper Clock Input Frequency**



- This is an example application to limit upper frequency  $f_H$  of clock pulses sent from the microcomputer. If the CK cycle sent from the microcomputer exceeds  $f_H$ , the circuit generates a reset signal. (The lower frequency has already been set using  $C_r$ .)
- When a clock pulse such as shown below is sent to pin CK, a short  $T_2$  prevents  $C_2$  voltage from reaching the CK input threshold level ( $\approx 1.25V$ ), and will cause a reset signal to be output. The  $T_1$  value can be found using the following formula :



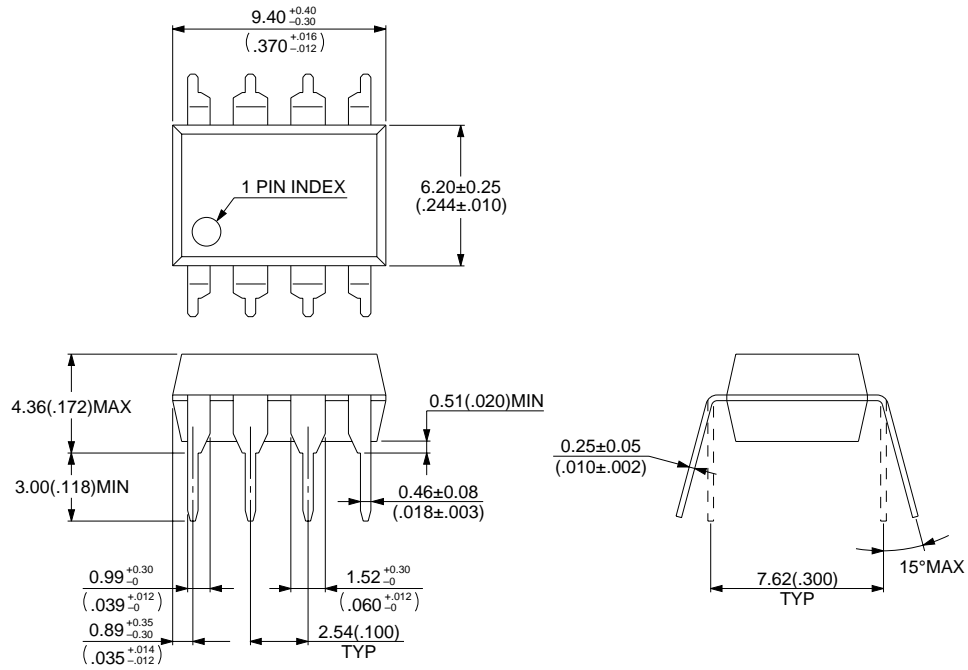
Example : Setting C and R allow the upper  $T_1$  value to be set (See the table below.)

C	R	$T_1$
0.01 $\mu\text{F}$	10k $\Omega$	30 $\mu\text{s}$
0.1 $\mu\text{F}$	10k $\Omega$	300 $\mu\text{s}$

# MB3773

## ■ PACKAGE DIMENSIONS

8 pin, Plastic DIP  
(DIP-8P-M01)

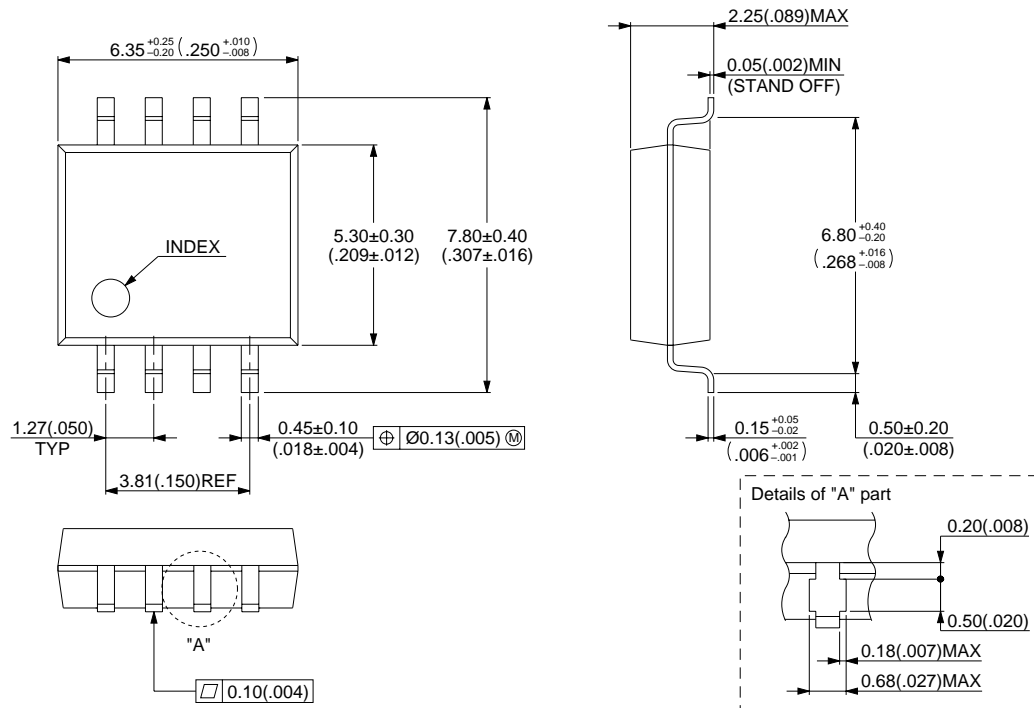


Dimensions in mm (inches).

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■ PACKAGE DIMENSIONS (Continued)

8 pin, Plastic SOP  
(FPT-8P-M01)

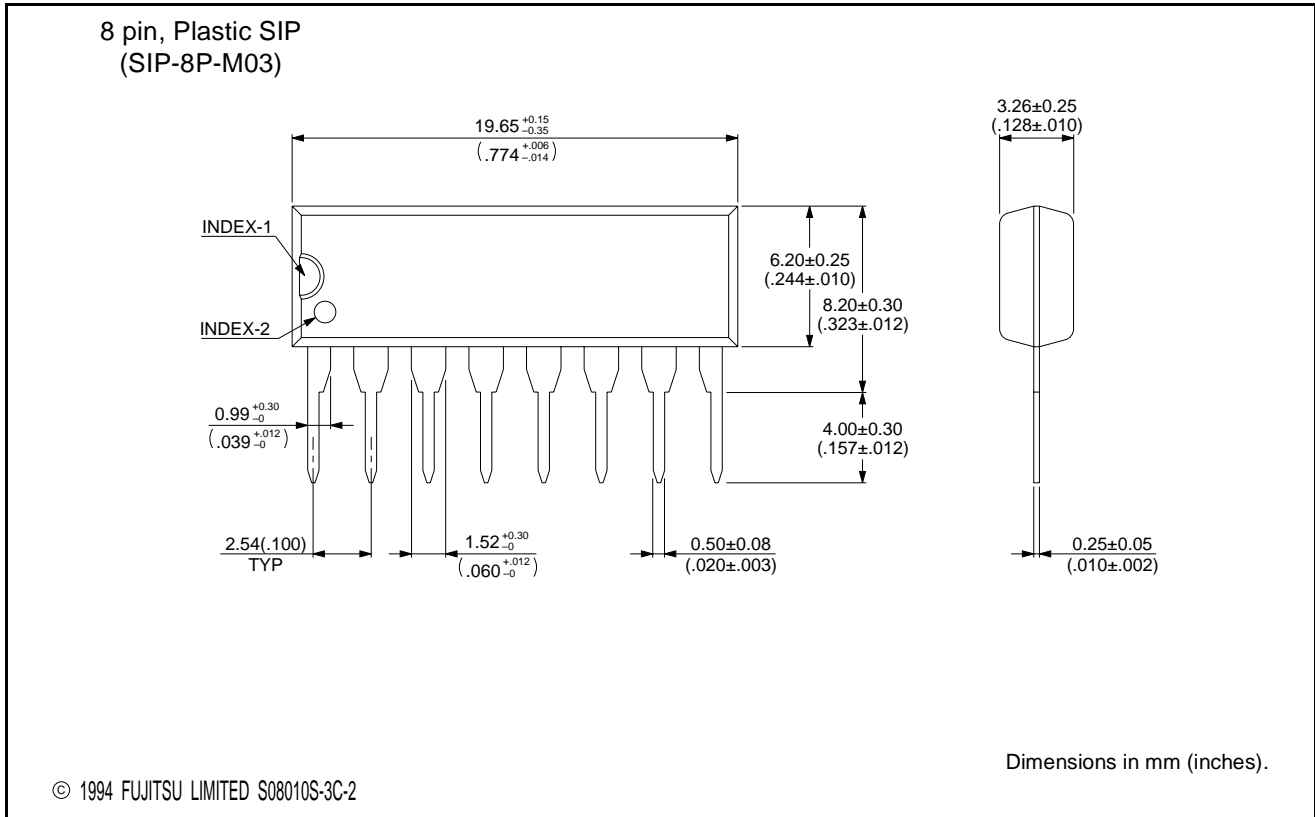


Dimensions in mm (inches).

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# MB3773

## ■ PACKAGE DIMENSIONS (Continued)





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