

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.

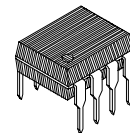
If the circuit's power supply deviates more than a specified amount, then the MB3773 generates a reset signal to the microprocessor. Thus, the computer data is protected from accidental erasure.

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.

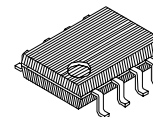
Using the MB3773 requires few external components. To monitor only a +5 volt supply, the MB3773 requires the connection of one external capacitor.

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

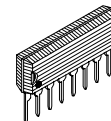
- Precision voltage detection ($V_s = 4.2V \pm 2.5\%$)
- Threshold level with hysteresis
- Low voltage output for reset signal ($V_{cc} = 0.8V$ typ.)
- Precision reference voltage output ($V_{REF} = 1.245 V \pm 1.5\%$)
- External clock monitor and reset signal generator
- Negative-edge input watch-dog 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

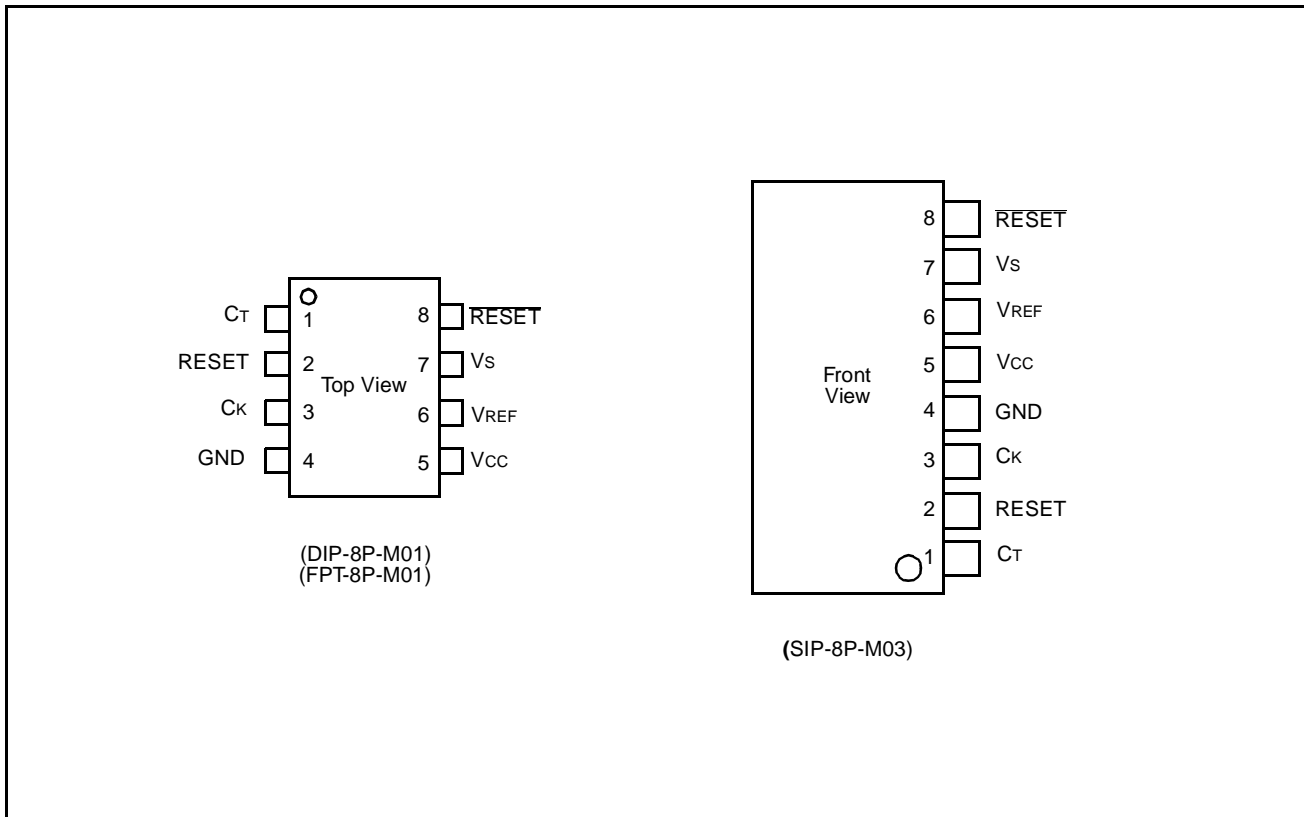


PLASTIC PACKAGE
SIP-8P-M03

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

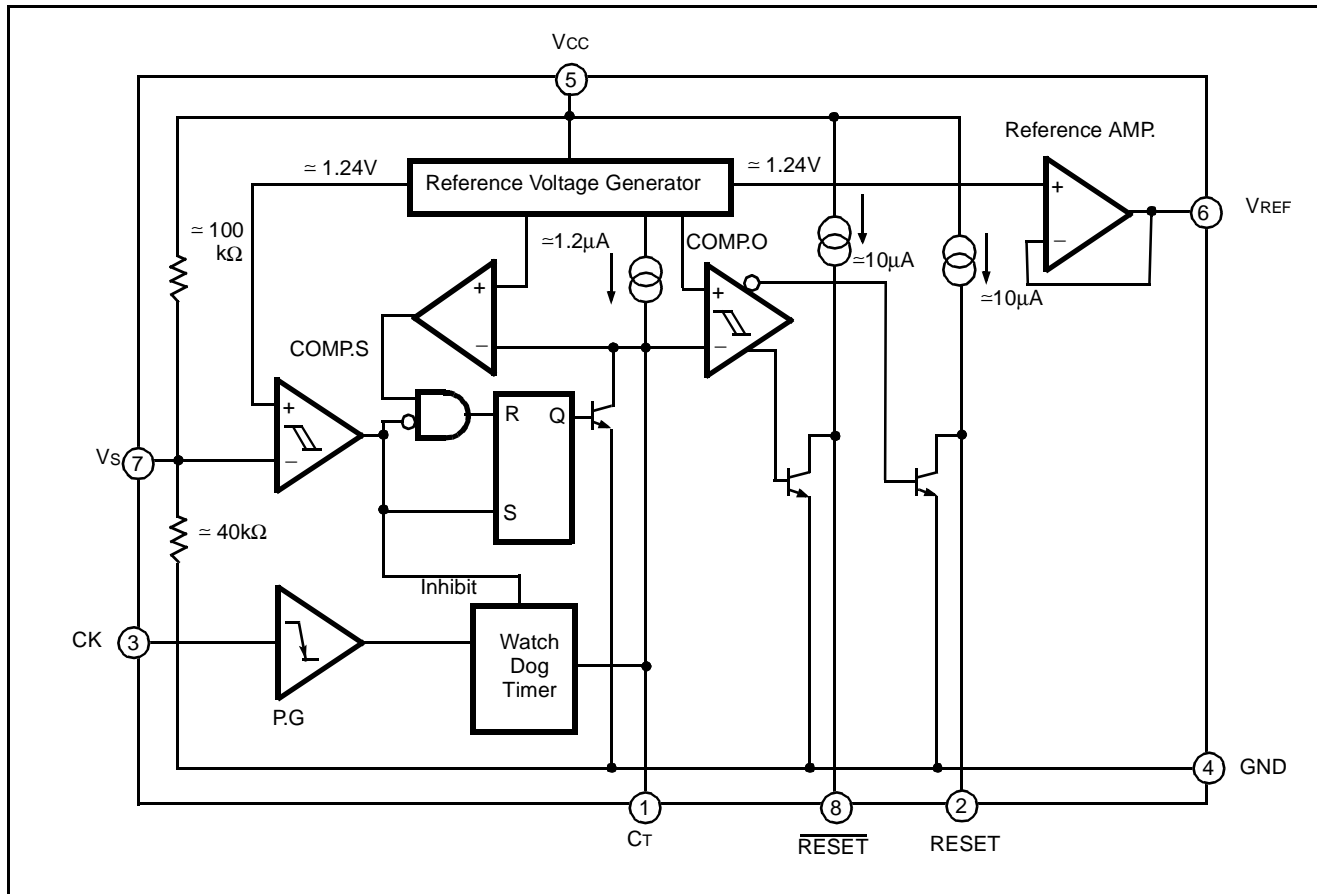


■ ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Rating | Unit |
|---|------------------|---|------|
| Supply voltage | V _{CC} | -0.3 to +18 | V |
| Input voltage | V _S | -0.3 to V _{CC} +0.3 ($\leq +18$) | V |
| | V _S | -0.3 to +18 | V |
| RESET, RESET Supply voltage | V _{OH} | -0.3 to V _{CC} +0.3 ($\leq +18$) | V |
| Power dissipation (T _a ≤ 85°C) | P _D | 200 | mW |
| Storage temperature | T _{STG} | -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



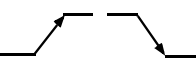
| Parameter | Symbol | Value | Unit |
|-------------------------------|----------|-------------|--------------------|
| Supply voltage | VCC | +3.5 to +16 | V |
| Reset, reset sink current | IOL | 0 to 20 | mA |
| VREF output current | IOUT | -200 to +5 | μA |
| Watch clock setting time | tWD | 0.1 to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

MB3773

■ ELECTRICAL CHARACTERISTICS

(1) DC Characteristics

(V_{CC}=5V, T_a=25°C)

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

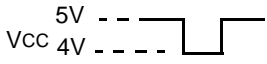
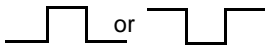

(1) DC Characteristics (Continued)

(V_{CC}=5V, T_a=25°C)

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

(2) AC Characteristics

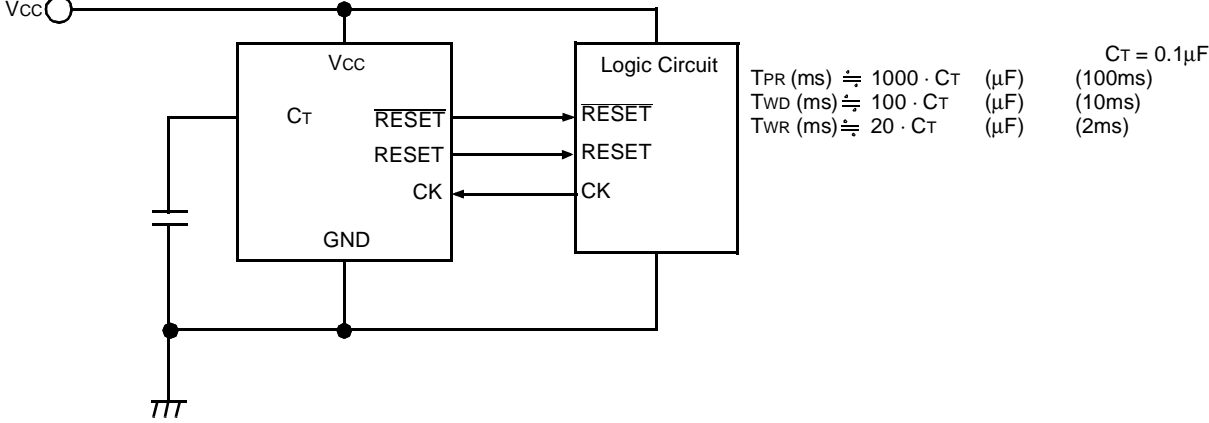
(V_{CC}=5V, T_a=25°C)

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

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

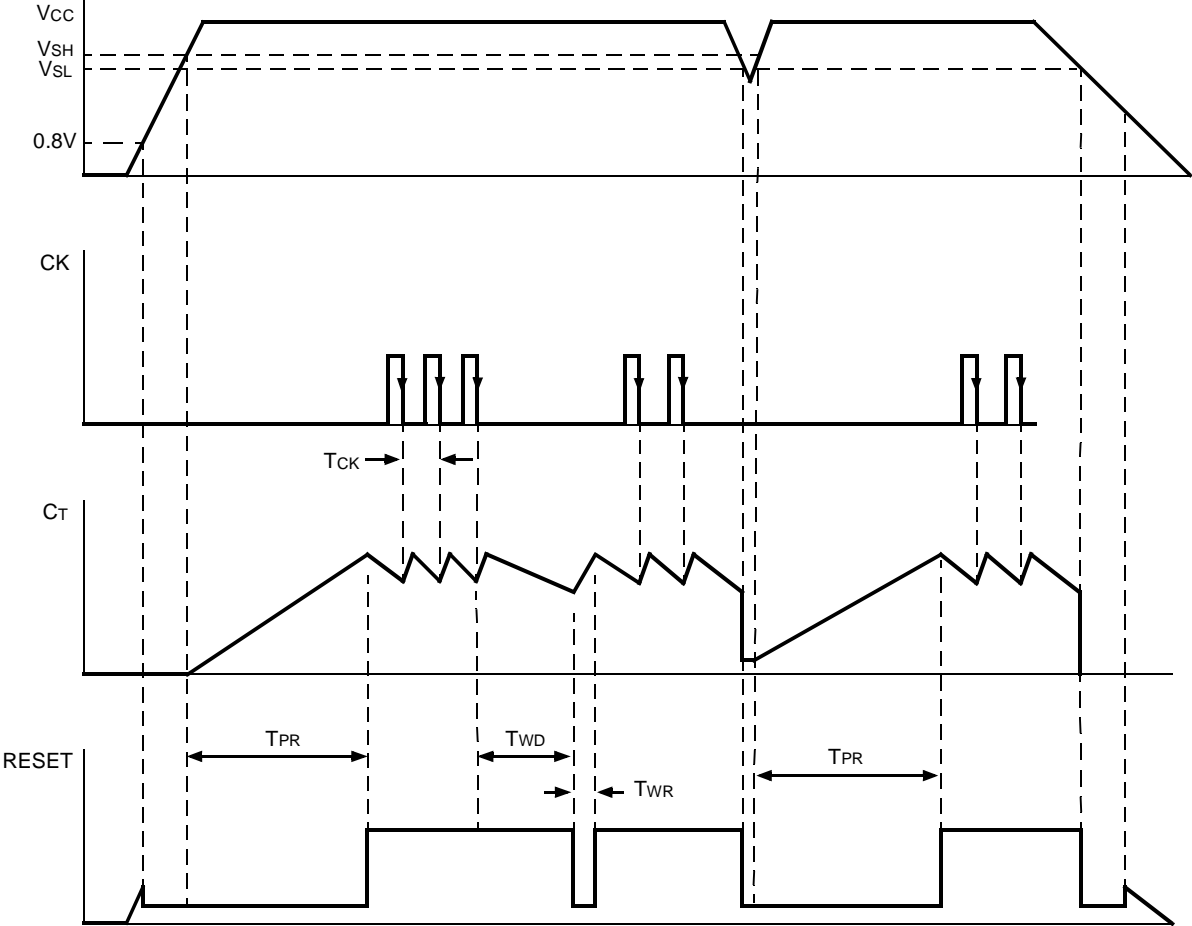
MB3773

Fig. 1 - MB3773 Basic Operation



$C_T = 0.1\mu F$

| | |
|---|---------|
| $T_{PR} (ms) \doteq 1000 \cdot C_T (\mu F)$ | (100ms) |
| $T_{WD} (ms) \doteq 100 \cdot C_T (\mu F)$ | (10ms) |
| $T_{WR} (ms) \doteq 20 \cdot C_T (\mu F)$ | (2ms) |



■ TYPICAL CHARACTERISTIC CURVES

Fig. 2 - Supply current vs. supply voltage

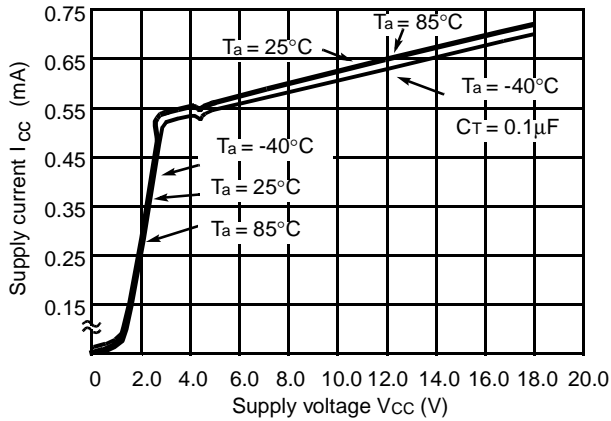


Fig. 4 - Output voltage vs. supply voltage

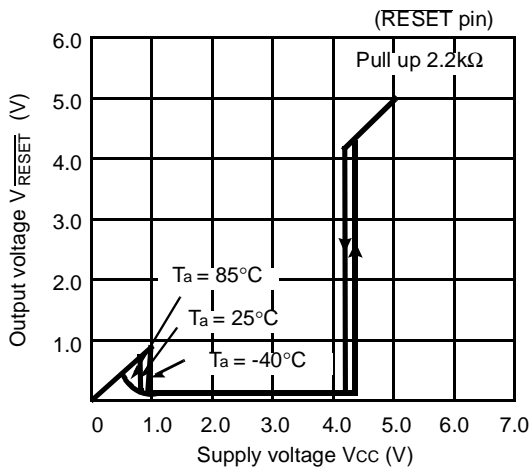


Fig. 6 - Output saturation voltage vs. output sink current

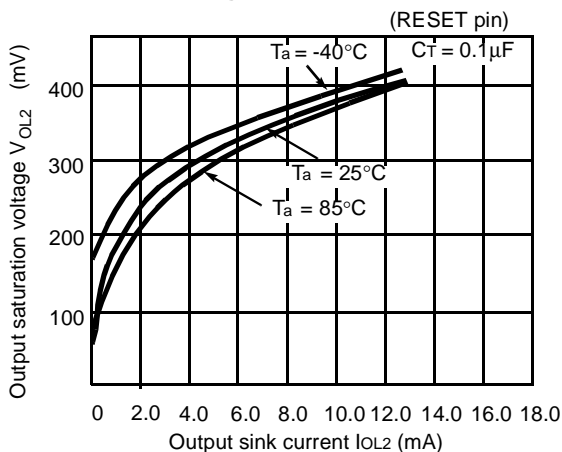


Fig. 3 - Output voltage vs. supply voltage

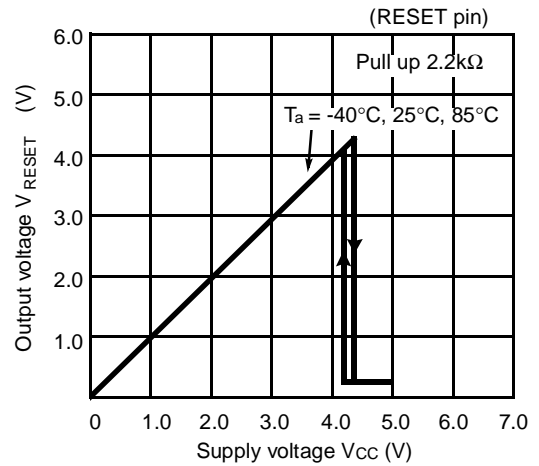


Fig. 5 - Detection voltage (VSH, VSL) vs. temperature

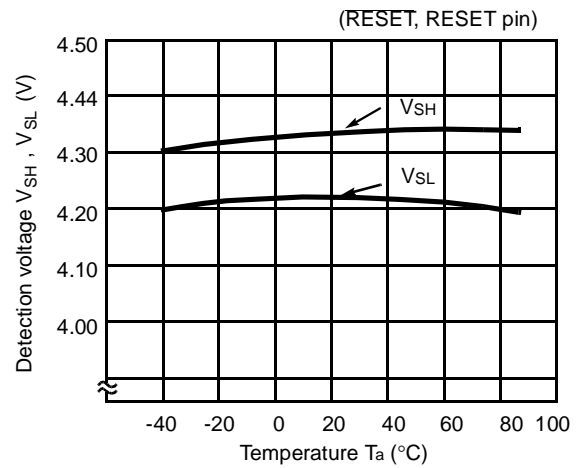
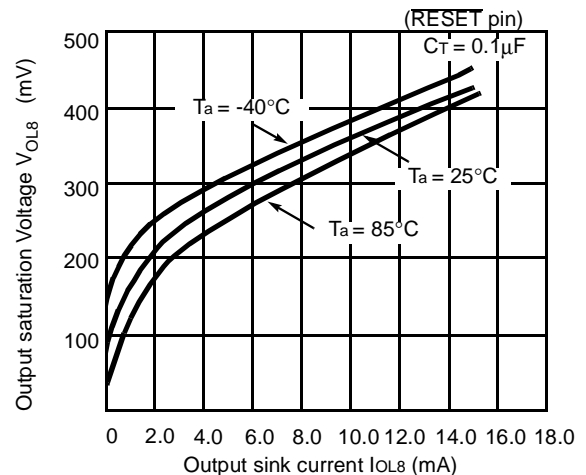


Fig. 7 - Output saturation voltage vs. output sink current



MB3773

■ TYPICAL CHARACTERISTIC CURVES (Continued)

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

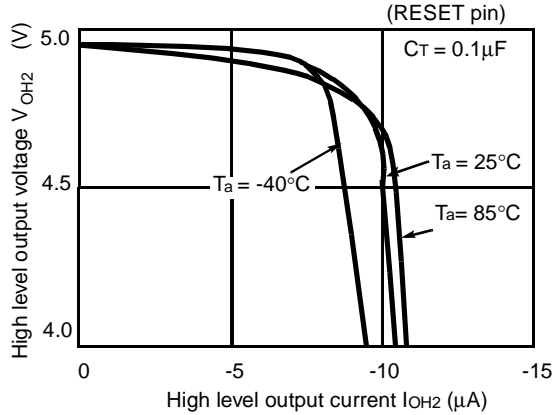


Fig. 9 - High level output voltage vs. high level output current

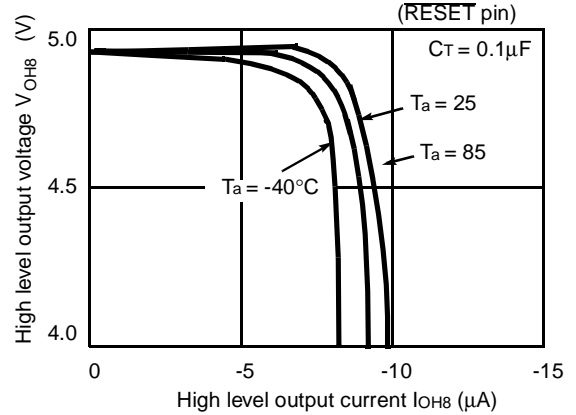


Fig. 10 - Reference voltage vs. supply voltage

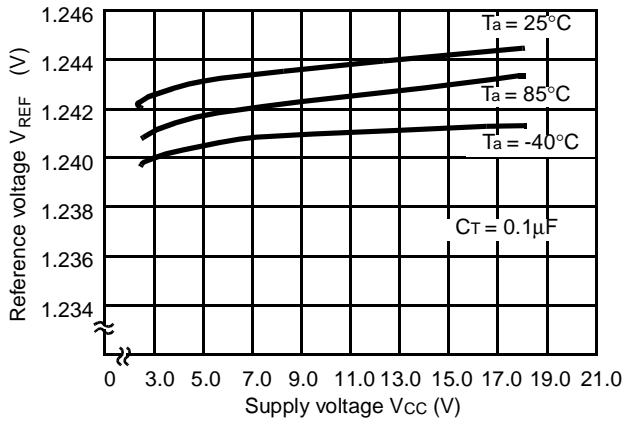


Fig. 11 - Reference voltage vs. reference current

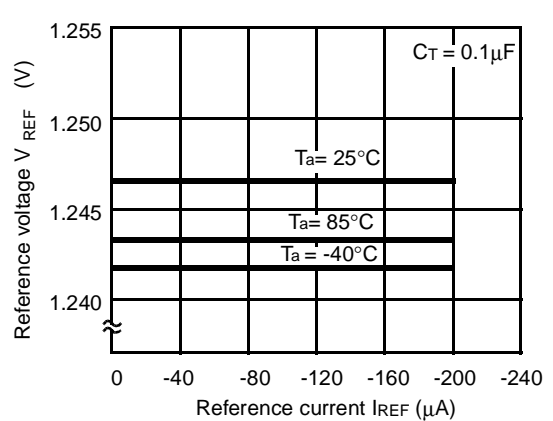


Fig. 12 - Reference voltage vs. temperature

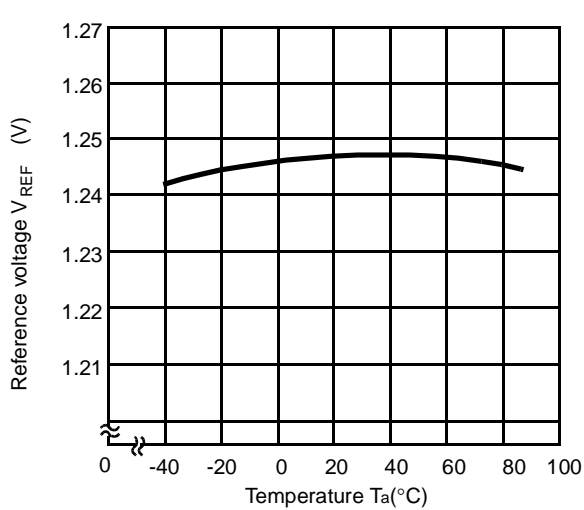
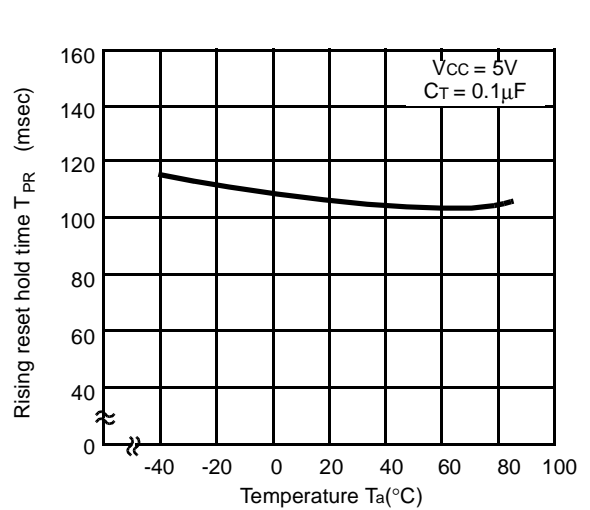


Fig. 13 - Rising reset hold time vs. temperature



■ TYPICAL CHARACTERISTIC CURVES (Continued)

Fig. 14 - Reset time vs. temperature

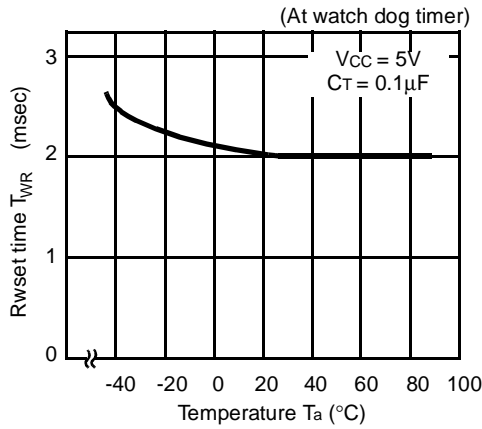


Fig. 15 - Watch dog timer watching time vs. temperature

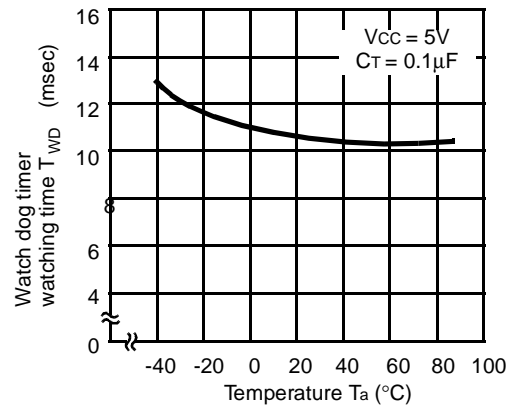


Fig. 16 - Terminal capacitance vs. rising reset hold time

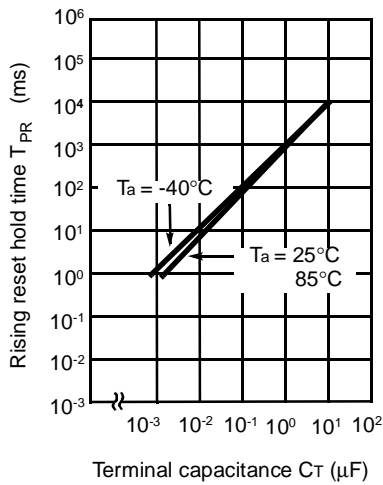


Fig. 17 - Terminal capacitance vs. reset time

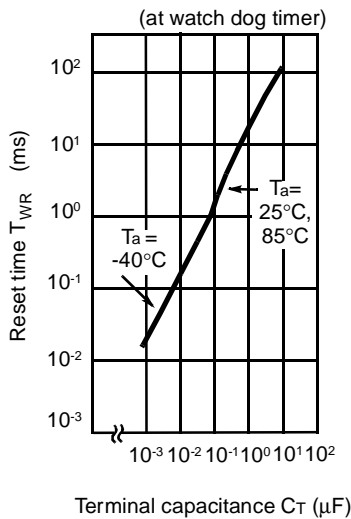
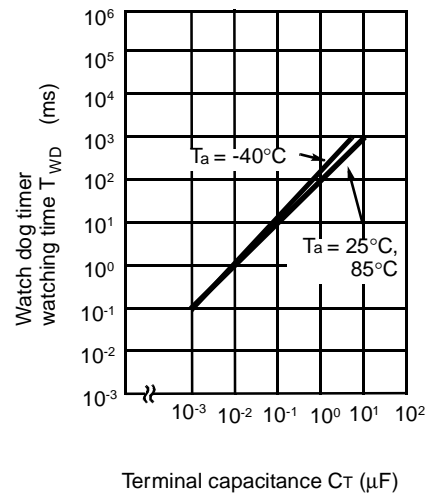


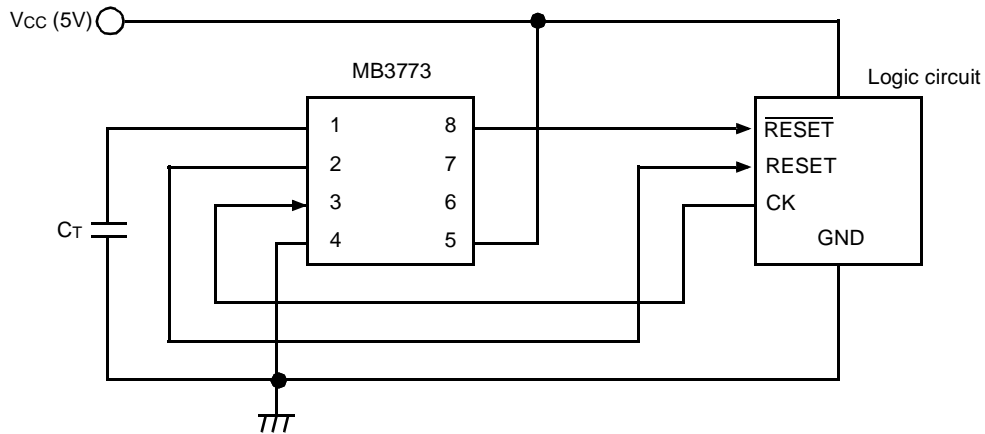
Fig. 18 - Terminal capacitance vs. watch dog timer watching time



MB3773

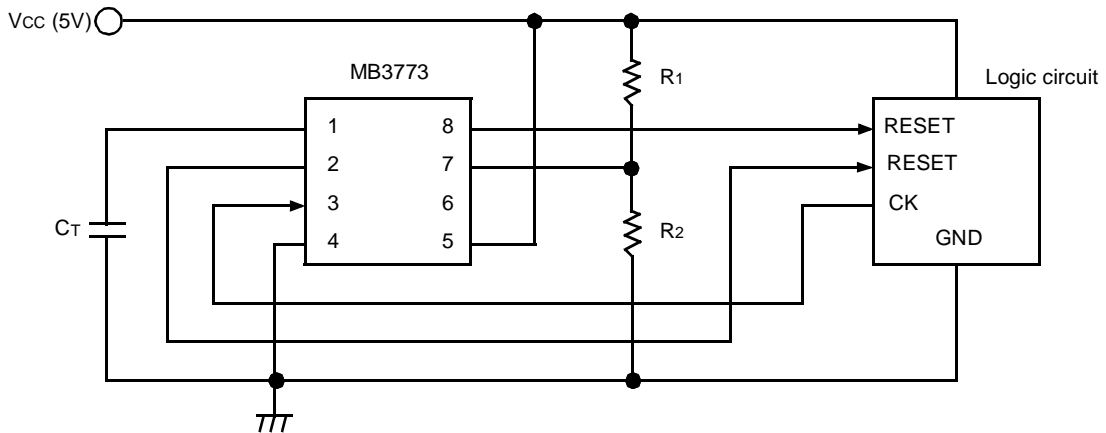
■ APPLICATION CIRCUIT

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



- Supply voltage is monitored using Vs.
Detection voltage are VSH and VSL.

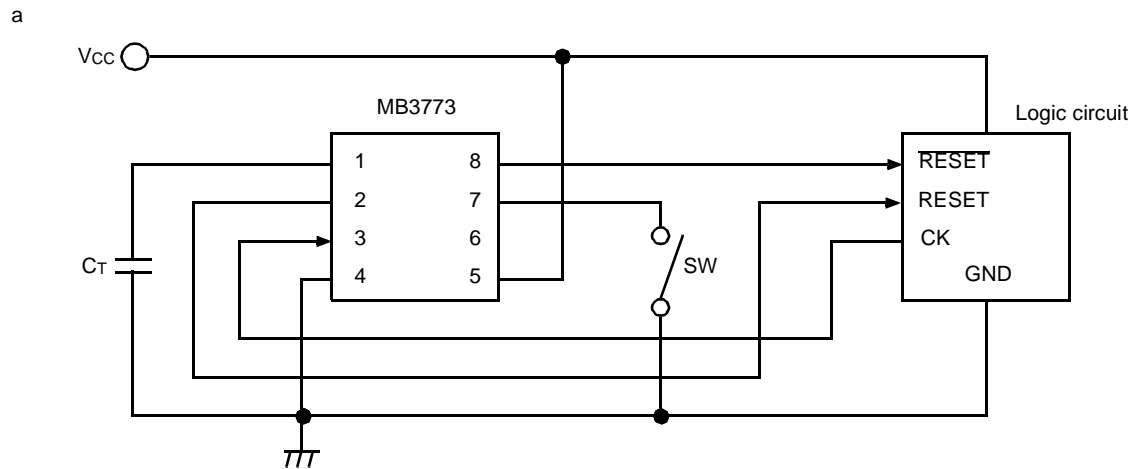
EXAMPLE 2 : 5V Supply Voltage Monitoring (external fine-tuning type)



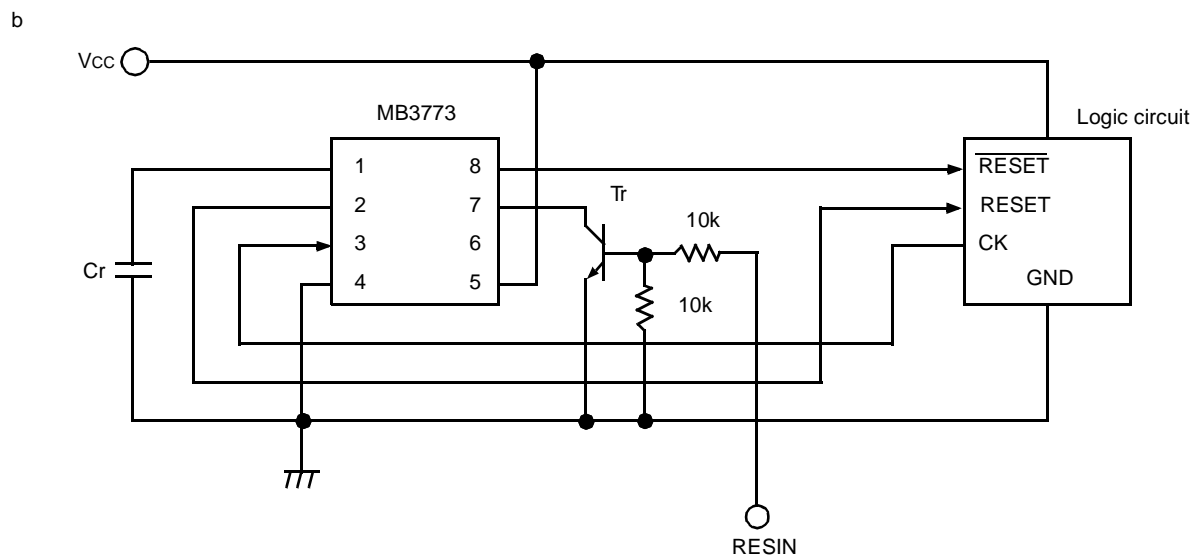
- Vs detection voltage can be adjusted externally.
- Selecting R₁ and R₂ values that are sufficiently lower than the resistance of the IC's internal voltage divider allows the detection voltage to be set according to the resistance ratio between R₁ and R₂. (See the table below.)

| R ₁ (kΩ) | R ₂ (kΩ) | Detection voltage:VsL (V) | Detection voltage:VSH (V) |
|---------------------|---------------------|---------------------------|---------------------------|
| 10 | 3.9 | 4.4 | 4.5 |
| 9.1 | 3.9 | 4.1 | 4.2 |

EXAMPLE 3 : With Forced Reset (with reset hold)



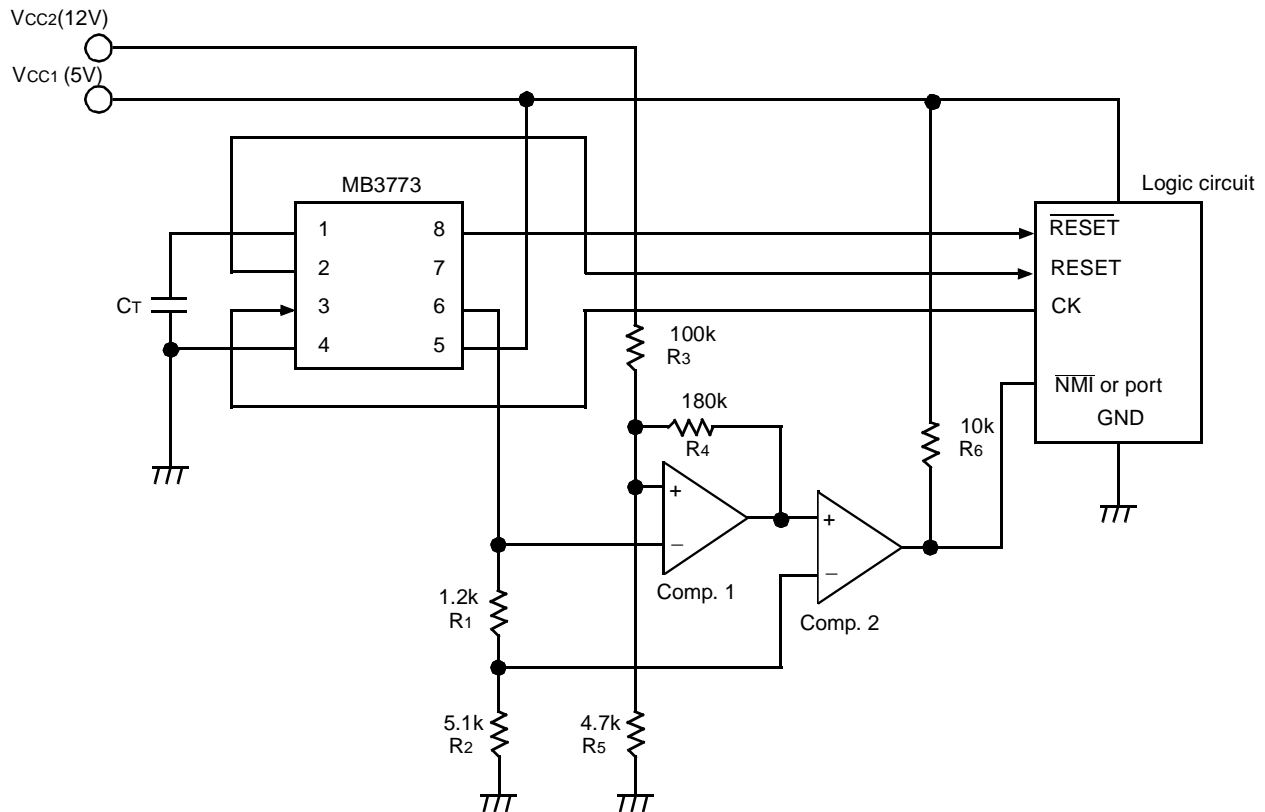
- Grounding pin 7 at the time of SW ON sets **RESET** (pin 8) to Low and RESET (pin 2) to High.



- 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

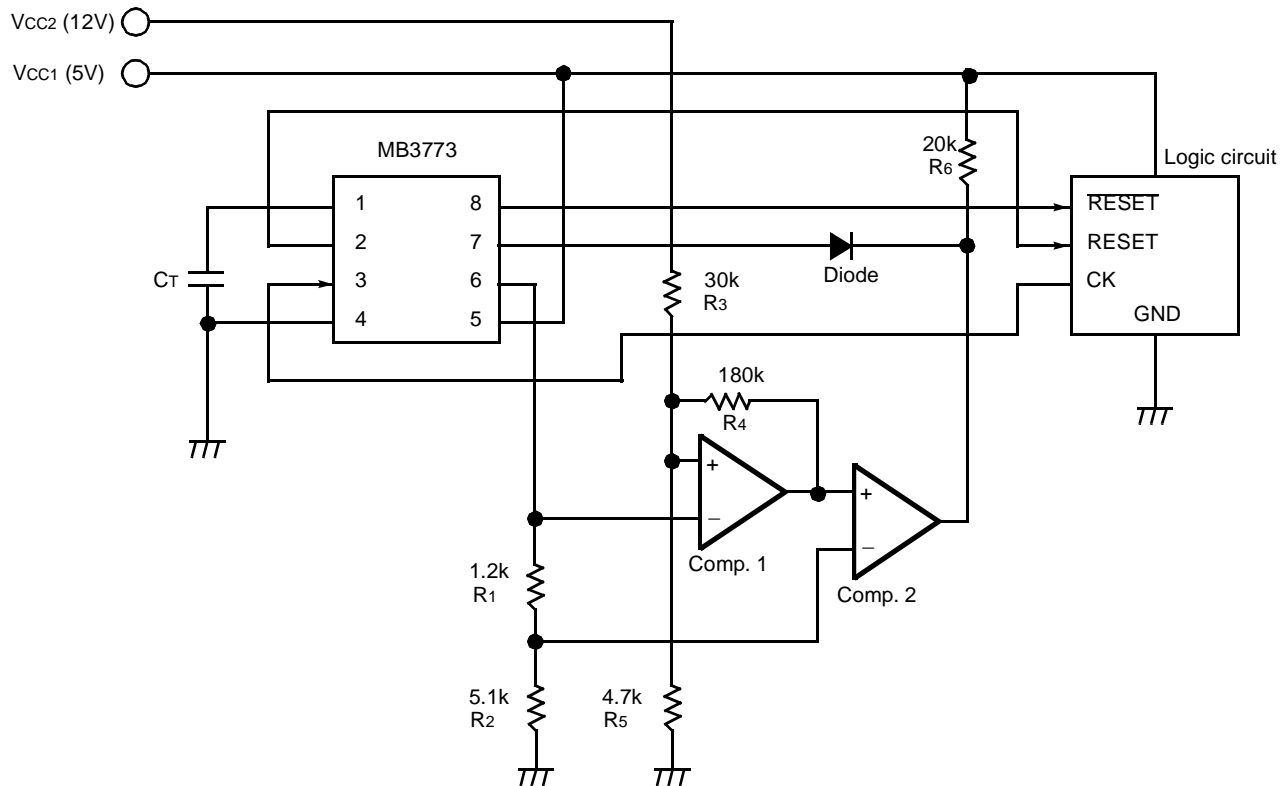
NOTE: The 5V supply voltage is monitored by the MB3773. The 12V supply voltage is monitored by the external circuit. Its output is connected to the $\overline{\text{NMI}}$ pin and, when voltage drops, Comp. 2 interrupts the logic circuit.

- 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)


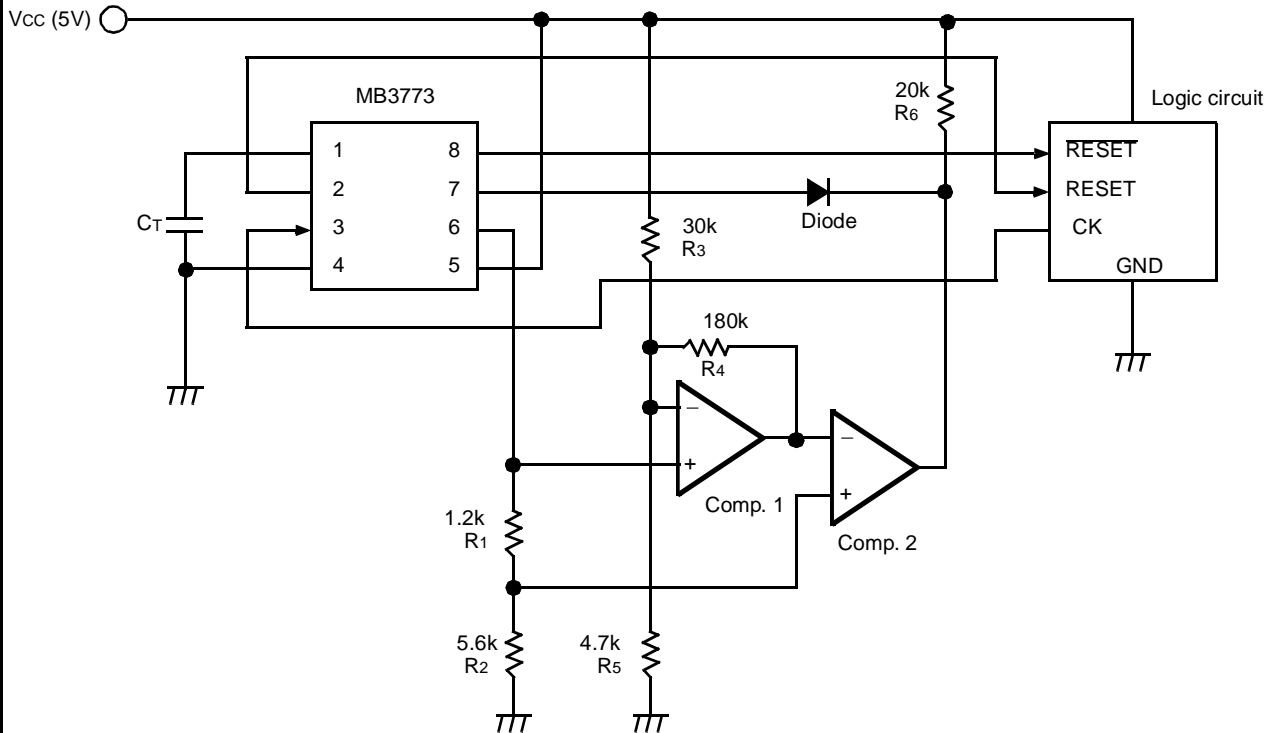
Example : Comp. 1, Comp. 2
: MB4204, MB47393

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.

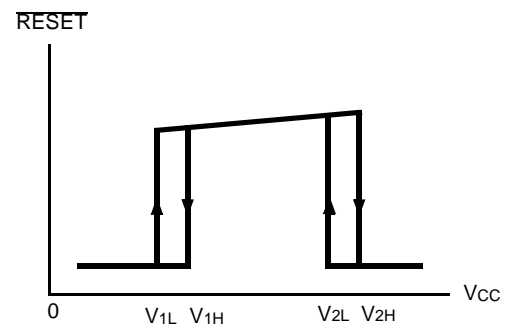
- Use VCC1 (=5V) to power the comparators (Comp. 1 and Comp. 2) in the external circuit shown above.
- The detection voltage of the VCC2 (=12V) supply voltage is approximately 9.2V/9.4V and has a hysteresis width of approximately 0.2V.
For the formulas for finding hysteresis width and detection voltage,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

MB3773

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

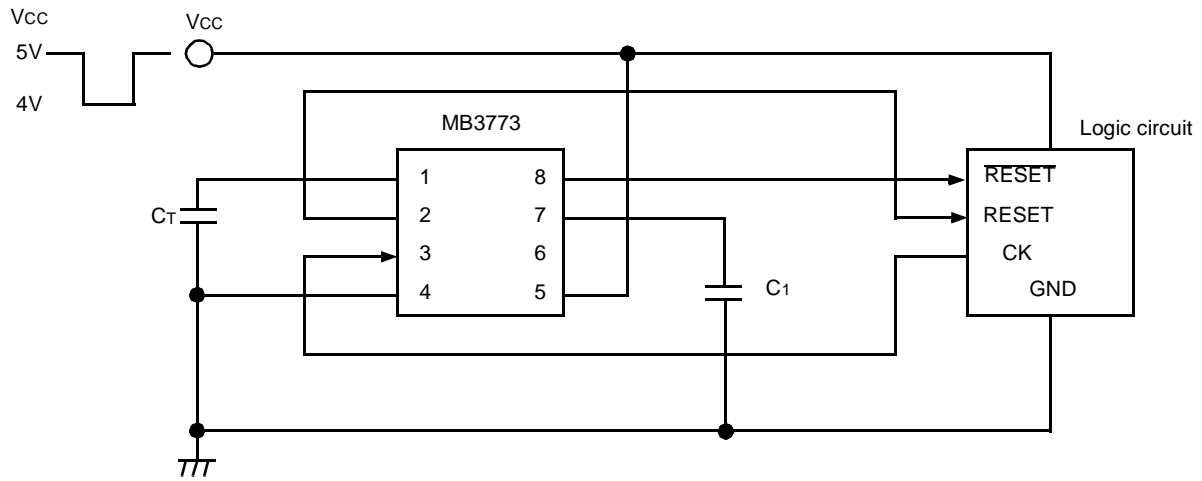


Example : Comp. 1, Comp. 2
: MB4204, MB47393



- 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



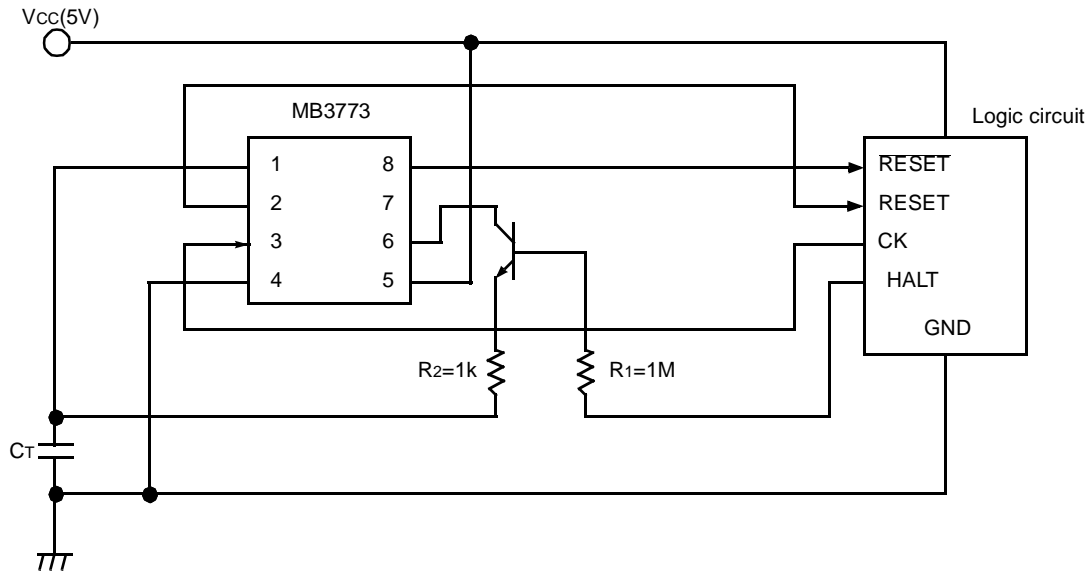
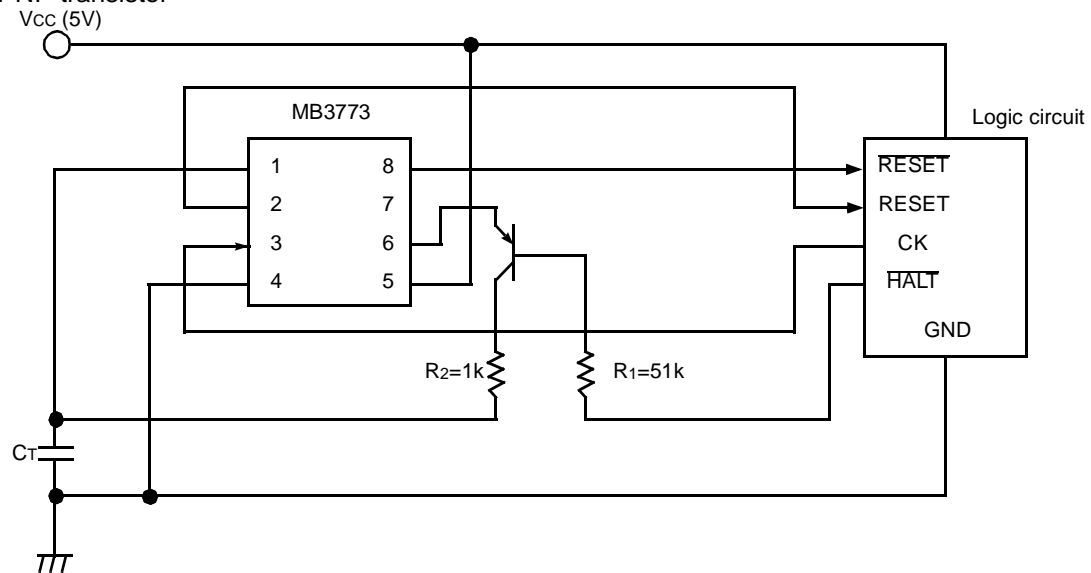
- Adding voltage such as shown in the figure to VCC increases the minimum input pulse width by 50 microseconds (C₁ = 1000pF).

MB3773

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.

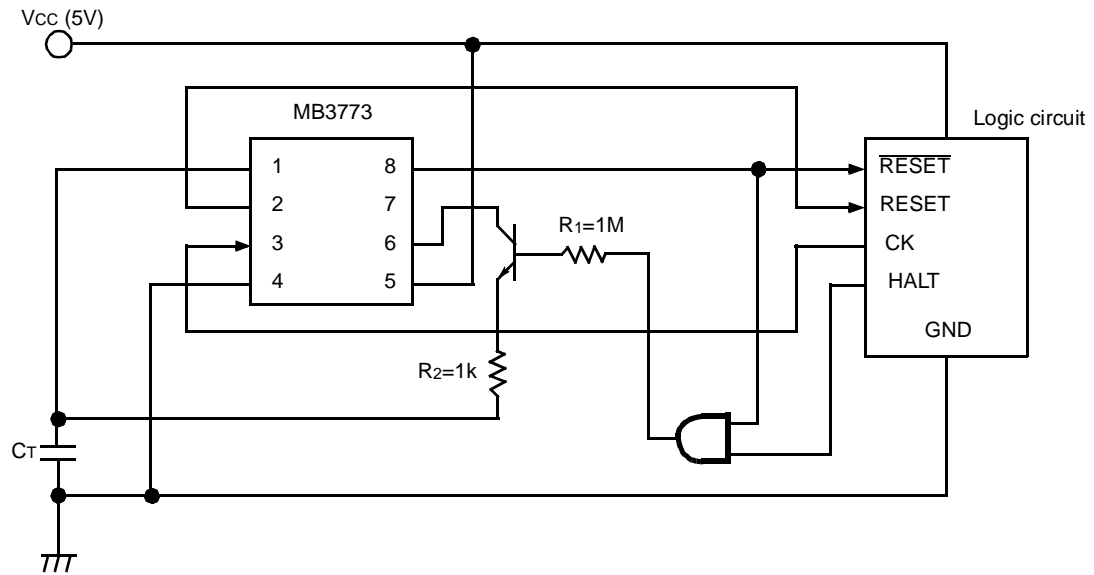
- The watch-dog timer is inhibited by clamping the Cr pin voltage to VREF .
The supply voltage is constantly monitored even while the watch-dog timer is inhibited.
For this reason, a reset signal is output at the occurrence of either instantaneous disruption or a sudden drop to low voltage.
Note that 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**

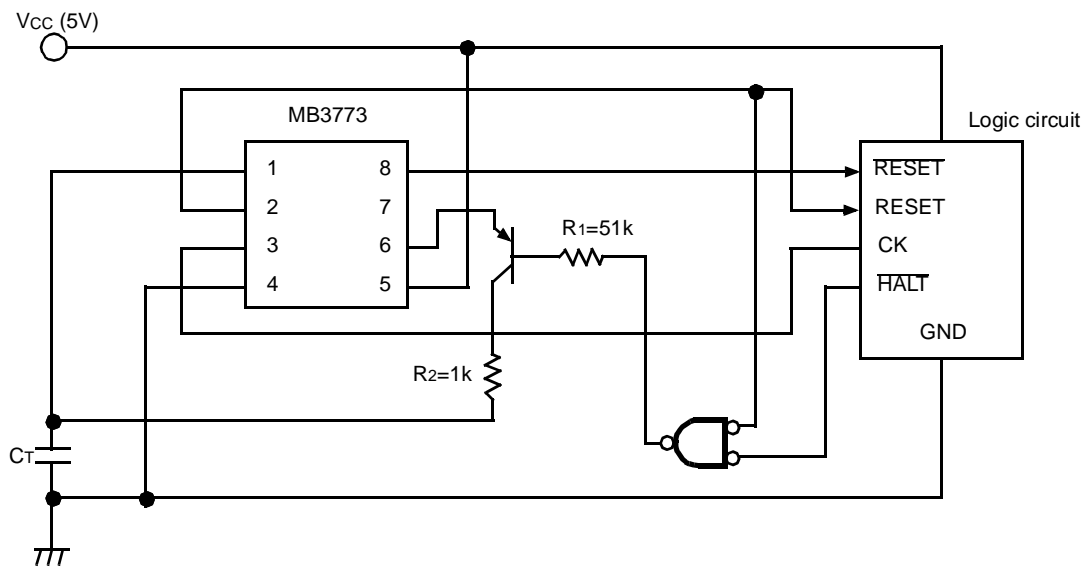
(Continued)

(Continued)

c Using NPN transistor

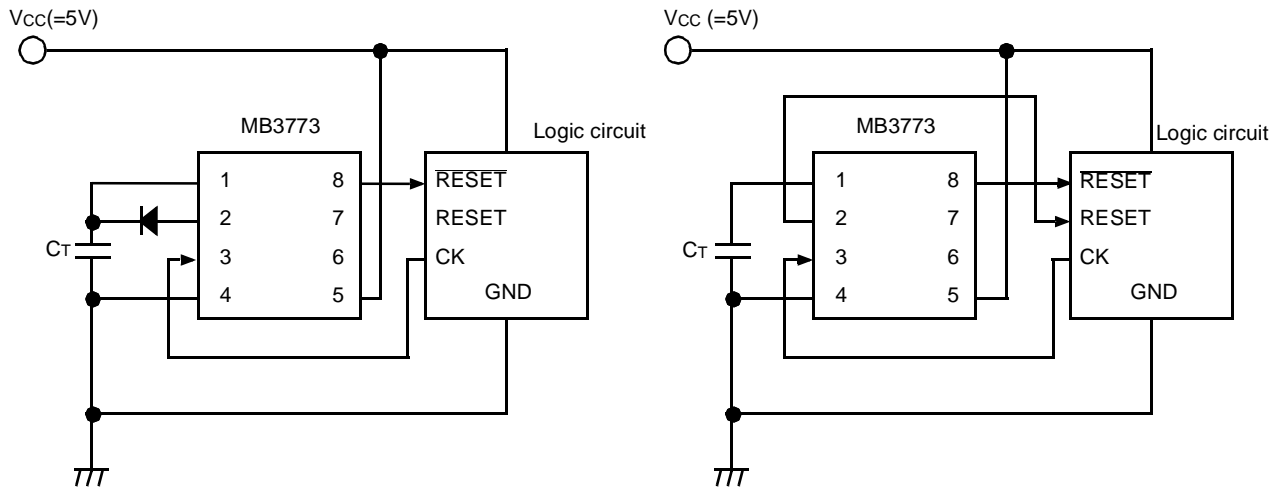


d Using PNP transistor



MB3773

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 :

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

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

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

- 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 = 0.1μF

| | T _{PR} reduction circuit | Standard circuit |
|-------------------|-----------------------------------|------------------|
| T _{PR} ≈ | 10ms | 100ms |
| T _{WD} ≈ | 10ms | 10ms |
| T _{WR} ≈ | 1.6ms | 2.0ms |

EXAMPLE 10 : Circuit for Monitoring Multiple Microcomputers

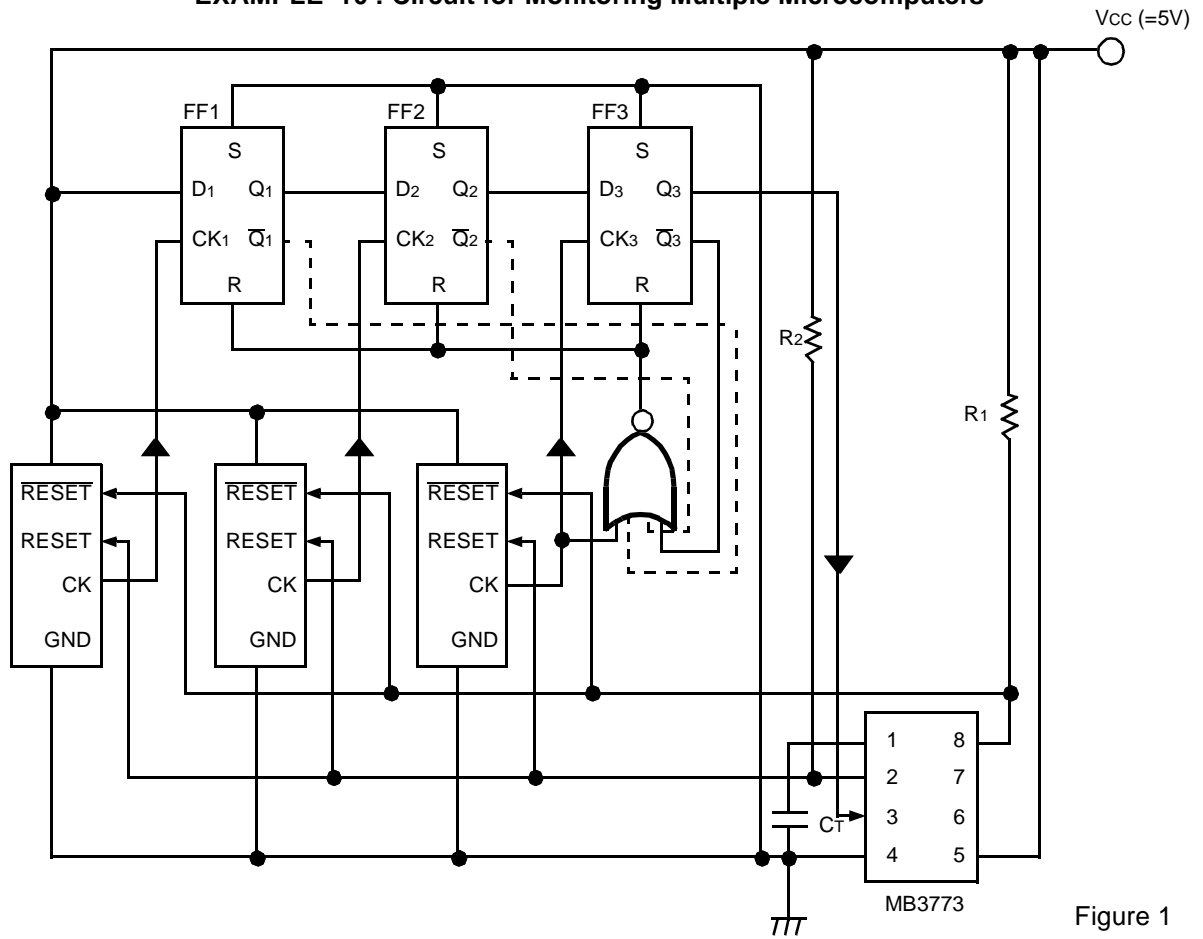


Figure 1

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

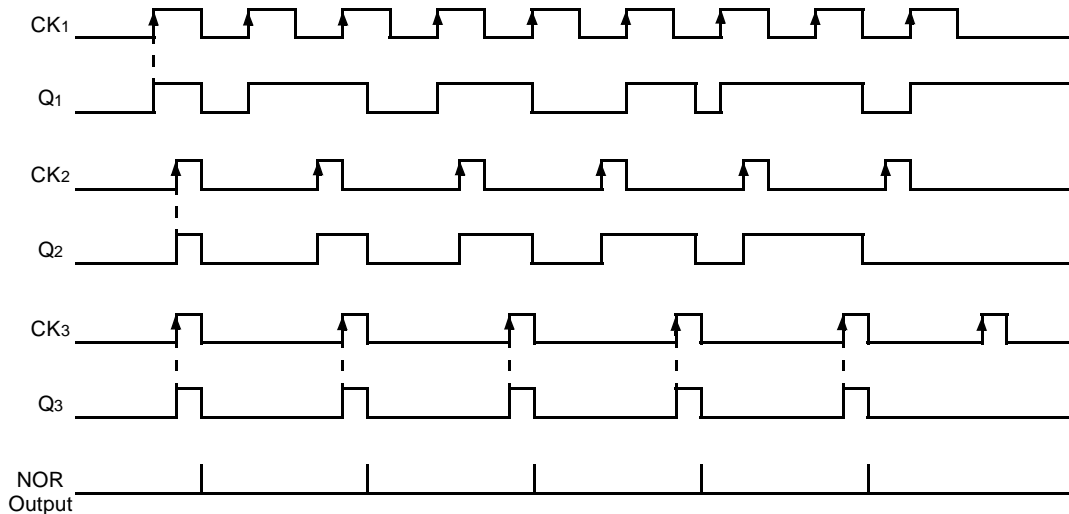


Figure 2

MB3773

Description of Application Circuits

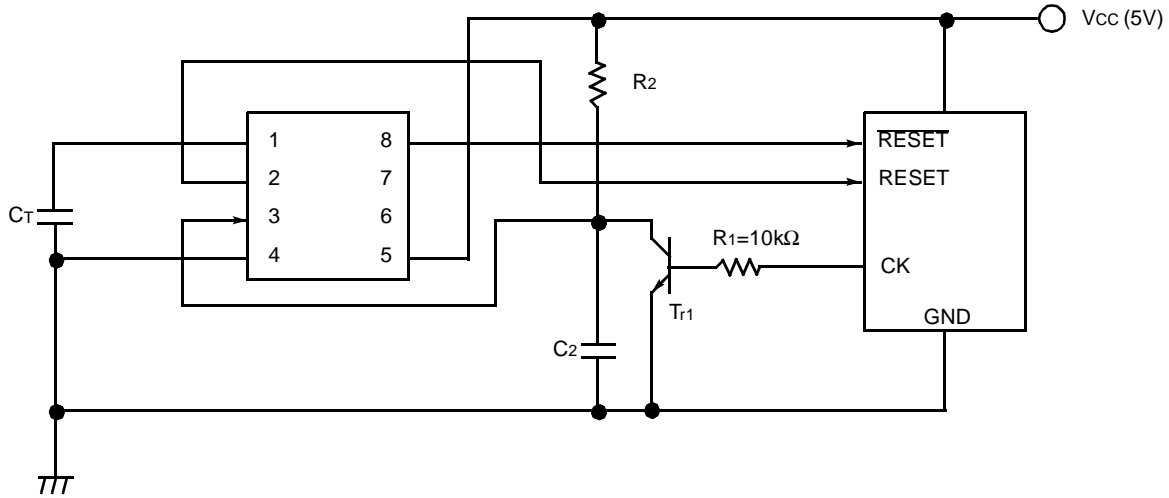
Using one MB3773, this application circuit monitors multiple microcomputers in one system. Signals from each microcomputer are sent to FF1, FF2 and FF3 clock inputs. Figure 2 shows these timings. Each flip-flop operates using signals sent from microcomputers as its clock pulse. When even one signal stops, 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.

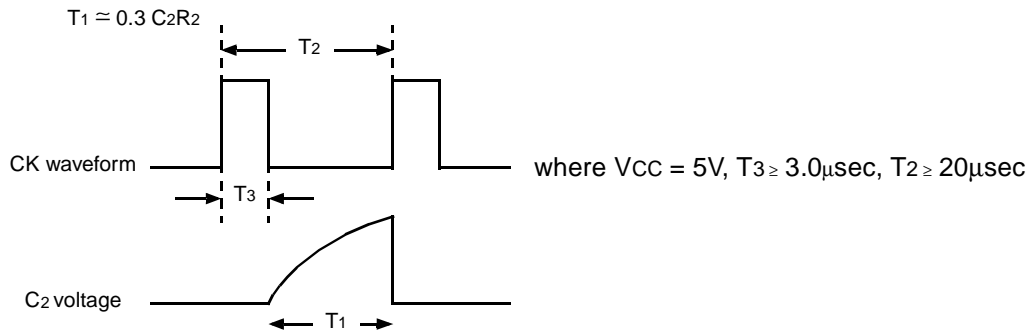
$$\Rightarrow \frac{1}{f_0} \leq \frac{1}{f} \leq \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$$

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 :



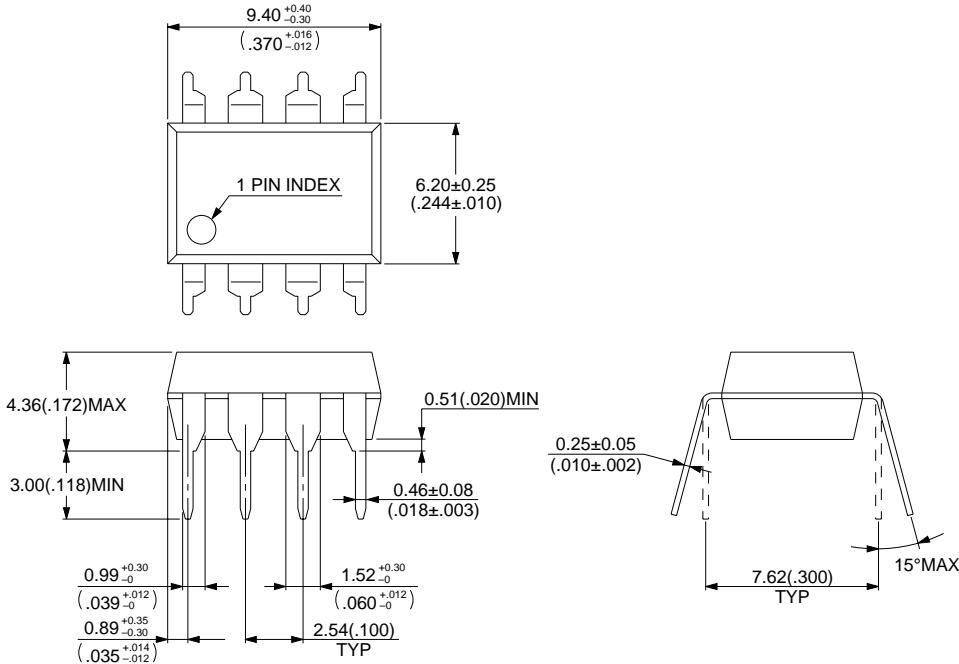
Example : Setting C and R allow the upper T_1 value to be set (See the table below.)

| C | R | T_1 |
|--------------------|--------------|-------------------|
| 0.01 μF | 10k Ω | 30 μs |
| 0.1 μF | 10k Ω | 300 μs |

MB3773

■ PACKAGE DIMENSIONS

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

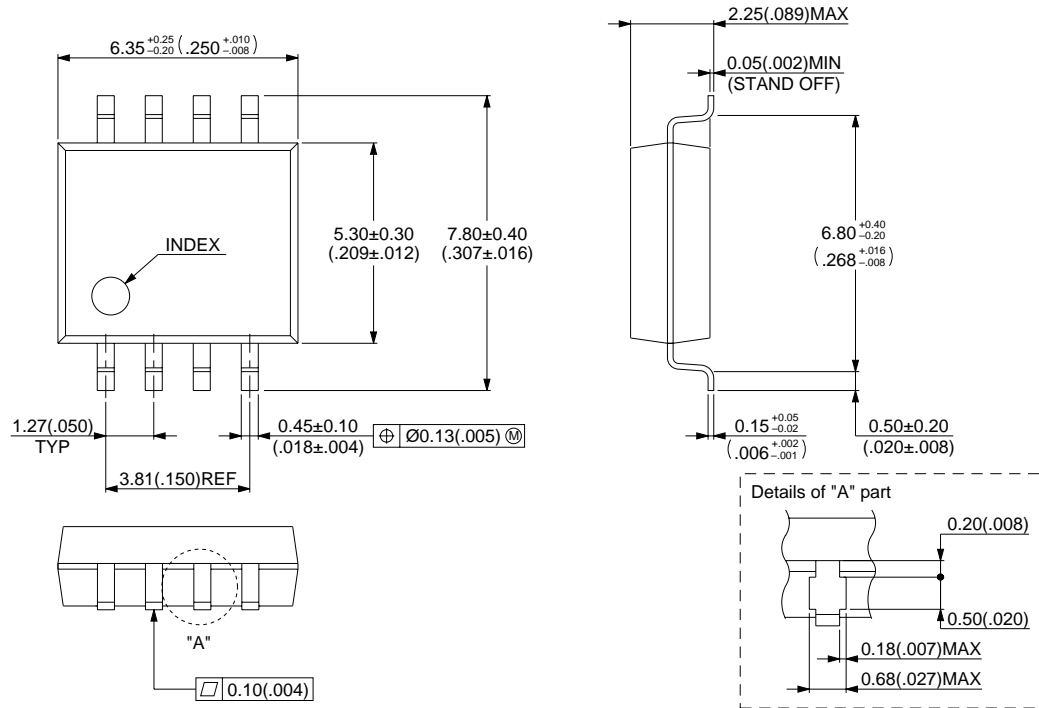


Dimensions in mm (inches).

© 1994 FUJITSU LIMITED D08006S-2C-3

■ PACKAGE DIMENSIONS (Continued)

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

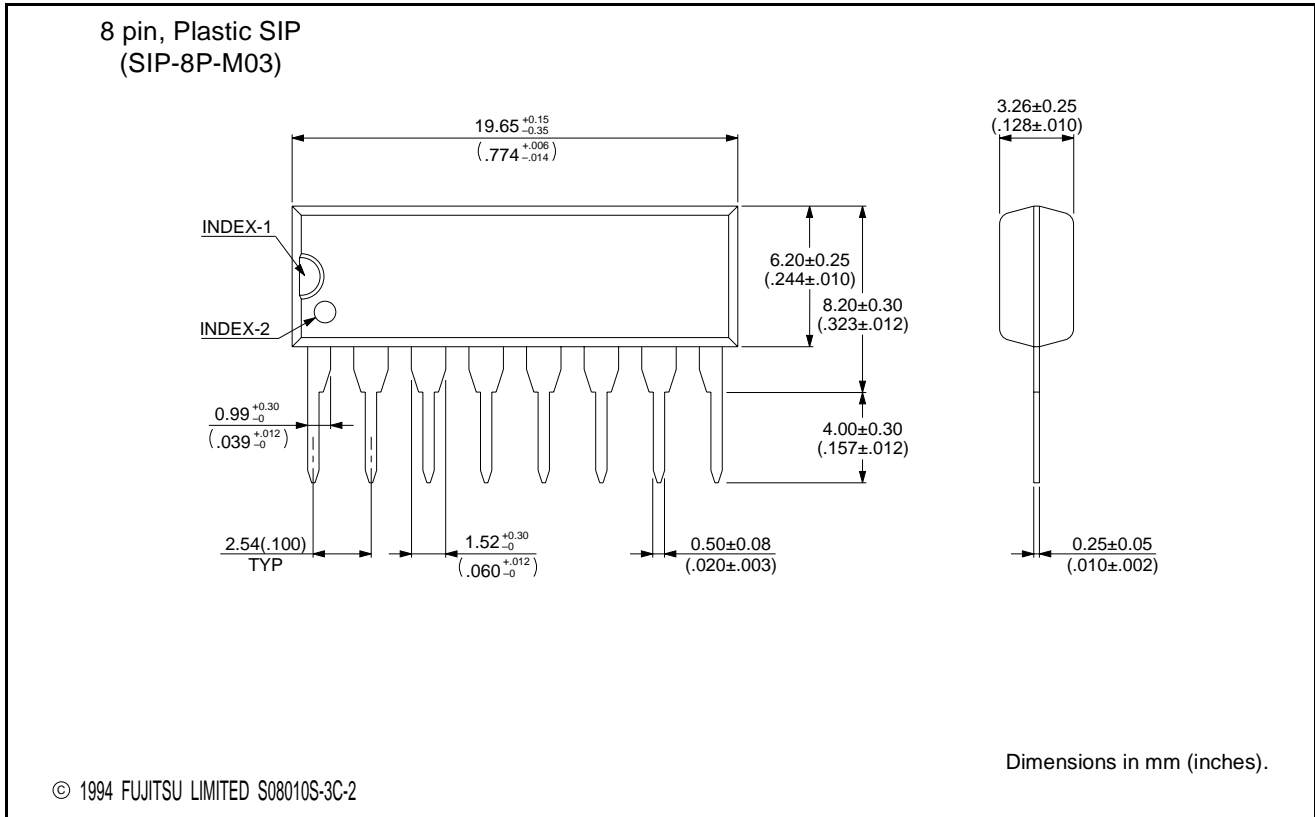


Dimensions in mm (inches).

© 1994 FUJITSU LIMITED F08002S-4C-4

MB3773

■ PACKAGE DIMENSIONS (Continued)



FUJITSU LIMITED

For further information please contact:

Japan

FUJITSU LIMITED
Corporate Global Business Support Division
Electronic Devices
KAWASAKI PLANT, 4-1-1, Kamikodanaka
Nakahara-ku, Kawasaki-shi
Kanagawa 211-8588, Japan
Tel: (044) 754-3763
Fax: (044) 754-3329

<http://www.fujitsu.co.jp/>

North and South America

FUJITSU MICROELECTRONICS, INC.
Semiconductor Division
3545 North First Street
San Jose, CA 95134-1804, USA
Tel: (408) 922-9000
Fax: (408) 922-9179

Customer Response Center
Mon. - Fri.: 7 am - 5 pm (PST)
Tel: (800) 866-8608
Fax: (408) 922-9179

<http://www.fujitsumicro.com/>

Europe

FUJITSU MIKROELEKTRONIK GmbH
Am Siebenstein 6-10
D-63303 Dreieich-Buchsschlag
Germany
Tel: (06103) 690-0
Fax: (06103) 690-122

<http://www.fujitsu-edc.com/>

Asia Pacific

FUJITSU MICROELECTRONICS ASIA PTE LTD
#05-08, 151 Lorong Chuan
New Tech Park
Singapore 556741
Tel: (65) 281-0770
Fax: (65) 281-0220

<http://www.fmap.com.sg/>

F9803

© FUJITSU LIMITED Printed in Japan

All Rights Reserved.

The contents of this document are subject to change without notice. Customers are advised to consult with FUJITSU sales representatives before ordering.

The information and circuit diagrams in this document presented as examples of semiconductor device applications, and are not intended to be incorporated in devices for actual use. Also, FUJITSU is unable to assume responsibility for infringement of any patent rights or other rights of third parties arising from the use of this information or circuit diagrams.

FUJITSU semiconductor devices are intended for use in standard applications (computers, office automation and other office equipment, industrial, communications, and measurement equipment, personal or household devices, etc.).

CAUTION:

Customers considering the use of our products in special applications where failure or abnormal operation may directly affect human lives or cause physical injury or property damage, or where extremely high levels of reliability are demanded (such as aerospace systems, atomic energy controls, sea floor repeaters, vehicle operating controls, medical devices for life support, etc.) are requested to consult with FUJITSU sales representatives before such use. The company will not be responsible for damages arising from such use without prior approval.

Any semiconductor devices have inherently a certain rate of failure. You must protect against injury, damage or loss from such failures by incorporating safety design measures into your facility and equipment such as redundancy, fire protection, and prevention of over-current levels and other abnormal operating conditions.

If any products described in this document represent goods or technologies subject to certain restrictions on export under the Foreign Exchange and Foreign Trade Control Law of Japan, the prior authorization by Japanese government should be required for export of those products from Japan.