

ASSP

POWER SUPPLY MONITOR

MB3771

POWER SUPPLY MONITOR

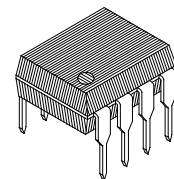
The Fujitsu MB3771 is designed to monitor the voltage level of one or two power supplies (+5V and an arbitrary voltage) in a microprocessor circuit, memory board in large-size computer, for example.

If the circuit's power supply deviates more than a specified amount, then the MB3771 generates a reset signal to the microprocessor. Thus, the computer data is protected from accidental erasure.

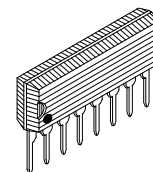
Using the MB3771 requires few external components. To monitor only a +5V supply, the MB3771 requires the connection of one external capacitor. The level of an arbitrary detection voltage is determined by two external resistors.

The MB3771 is available in an 8-pin Dual In-Line, Single In-Line Package or space saving Flat Package.

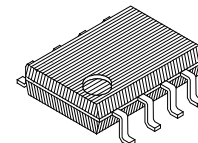
- Precision voltage detection ($V_{SA} = 4.2V \pm 2.5\%$)
- User selectable threshold level with hysteresis ($V_{SB} = 1.23V \pm 1.5\%$)
- Monitors the voltage of one or two power supplies (5V and an arbitrary voltage, $>1.23V$)
- Low voltage output for reset signal ($V_{CC} = 0.8V$ typ.)
- Minimal number of external components (one capacitor min.)
- Low power dissipation ($I_{CC} = 0.35$ mA typ., $V_{CC} = 5V$)
- Usable as over voltage detector
- Detection threshold voltage has hysteresis function
- Reference voltage is connectable.
- Available in a variety of packages
- 8-pin Dual In-Line Package
- 8-pin Single In-Line Package
- 8-pin Flat Package



PLASTIC PACKAGE
DIP-8P-M01



PLASTIC PACKAGE
SIP-8P-M03

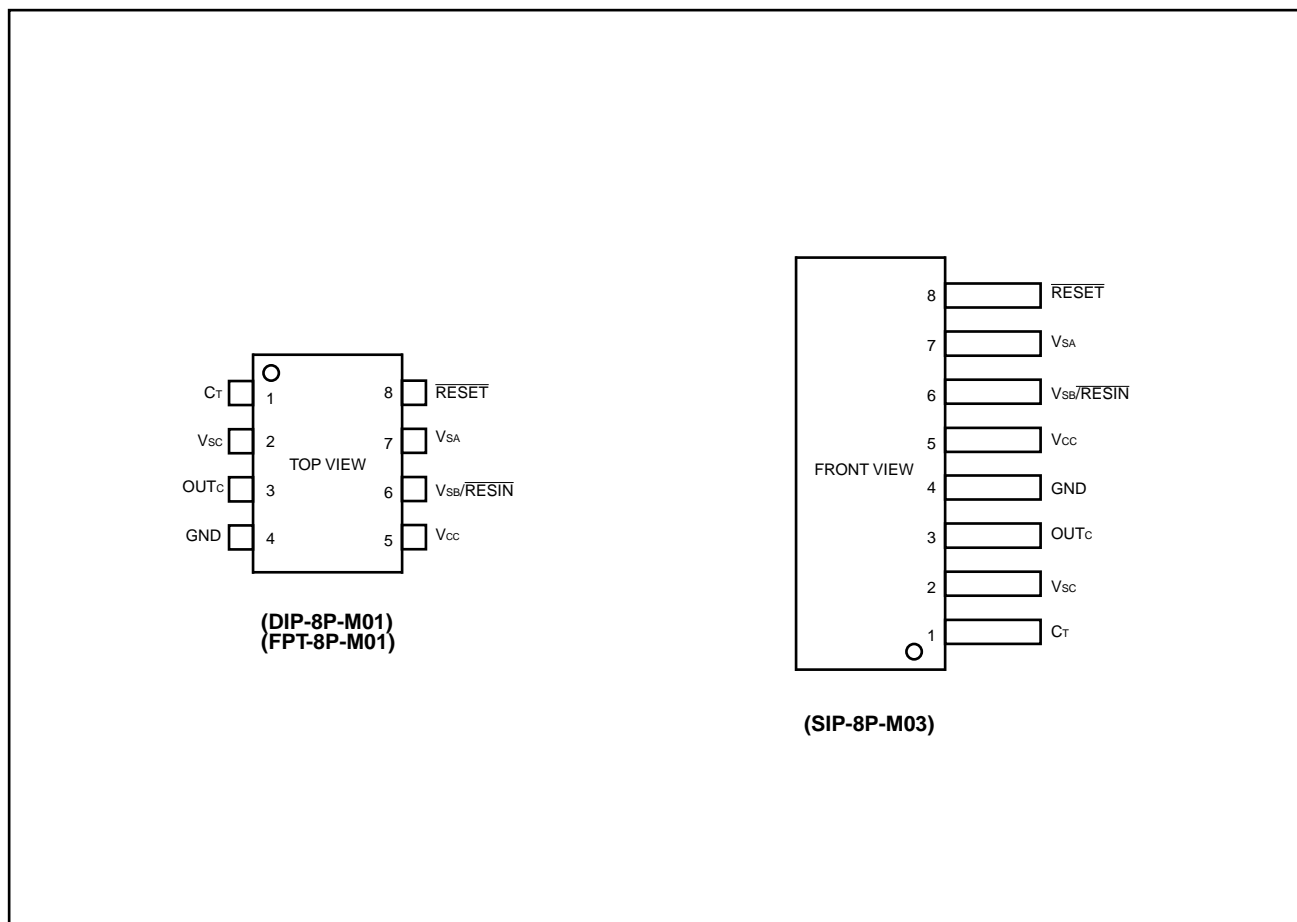


PLASTIC PACKAGE
FPT-8P-M01

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.

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■ PIN ASSIGNMENT

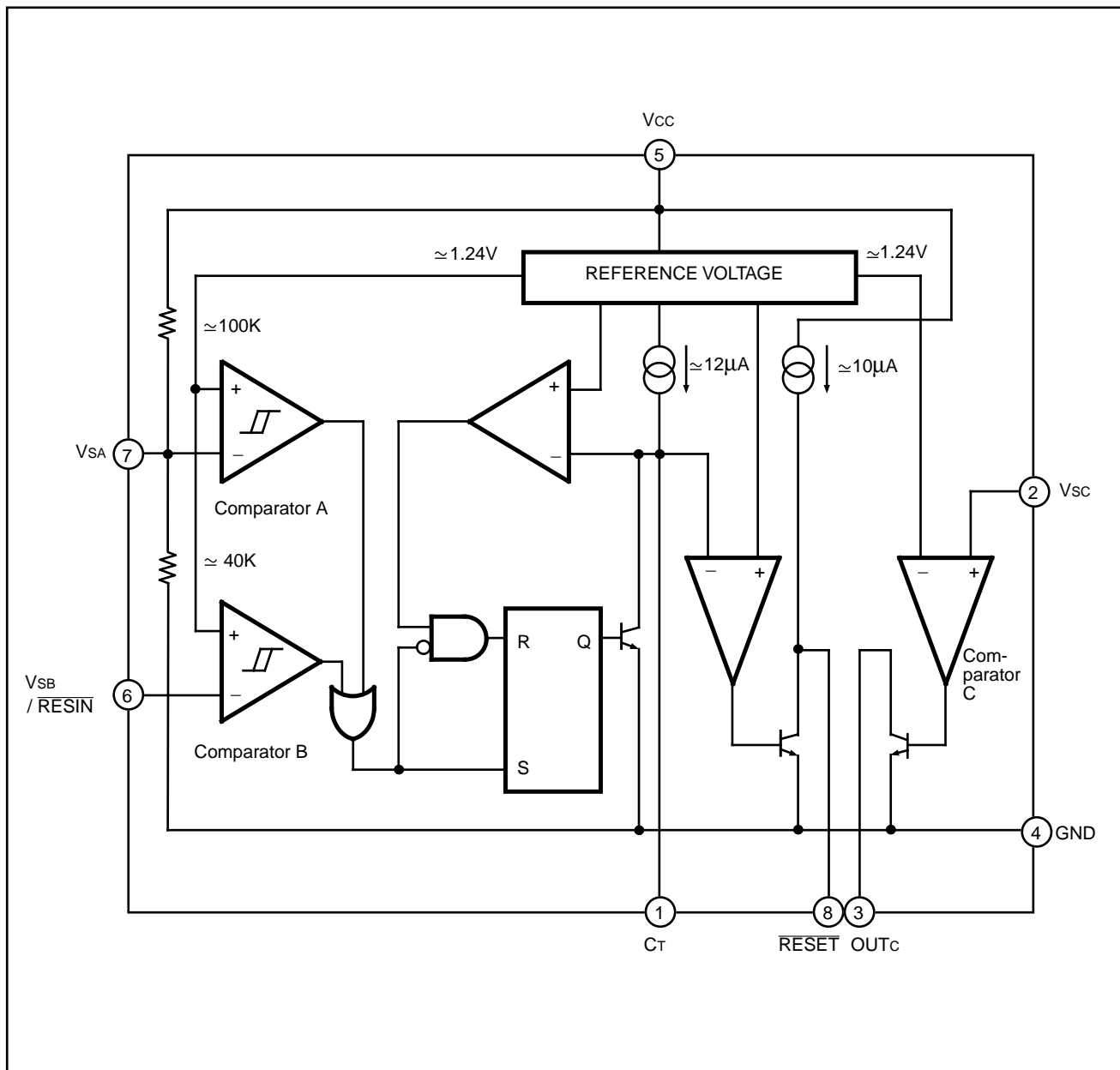


■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit
Supply Voltage	V_{CC}	-0.3 to +20	V
Input Voltage A	V_{SA}	-0.3 to $V_{CC} + 0.3$ ($< +20$)	V
Input Voltage B	V_{SB}	-0.3 to +20	V
Input Voltage C	V_{SC}	-0.3 to +20	V
Power Dissipation	PD	200 ($T_a \leq 85^\circ\text{C}$)	mW
Storage Temperature	TSTG	-55 to +125	$^\circ\text{C}$

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



FUNCTIONAL EXPLANATIONS

Detection voltage inputs A and B are connected to the inverting input of Comparators A and B respectively. Both comparators have built-in hysteresis. If either V_{SA} or V_{SB} drops lower than about 1.23V, then $\overline{\text{RESET}}$ goes low.

Comparator B is used for the arbitrary preset voltage detection (See Example 3), or as forced reset input for TTL logic level input. (See Example 6).

Comparator C is designed as an open-collector output with inverted polarity input/output characteristics. Comparator C has no hysteresis. It can be used for over-voltage detection (See Example 11), generation of $\overline{\text{RESET}}$ signal by positive logic (See Example 7), and generation of reference voltage (See Example 10).

Note that V_{SB} and V_{SC} should be connected with V_{CC} and GND respectively. (See Example 1).

The MB3771 can detect about 2 μs voltage sag/surge of the power supply. The user can add delayed trigger capacity by connecting a capacitor between inputs V_{SA} and V_{SS}. (See Example 8)

Internal pull-up resistor on the $\overline{\text{RESET}}$ line provides for high impedance loading (i.e. CMOS logic).

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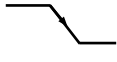
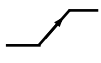

■ RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Rating	Unit
Supply Voltage	VCC	+3.5 to +18	V
Output Current (RESET)	I _{RESET}	0 to 20	mA
Output Current (OUTc)	I _{OUTC}	0 to 6	mA
Operating Ambient Temperature	T _a	-40 to +85	°C

■ ELECTRICAL CHARACTERISTICS

DC CHARACTERISTICS

(V_{CC} = 5V, T_a = 25°C)

Parameter	Condition	Symbol	Value			Unit
			Min	Typ	Max	
Supply Current	V _{SB} = 5V, V _{SC} = 0V	I _{CC1}	-	350	500	μA
	V _{SB} = 0V, V _{SC} = 0V	I _{CC2}	-	400	600	μA
Sagging Detection Voltage Falling	V _{CC} 	V _{SAL}	4.10	4.20	4.30	V
	T _a = -40 to +85°C		4.05	4.20	4.35	V
Rising	V _{CC} 	V _{SAH}	4.20	4.30	4.40	V
	T _a = -40 to +85°C		4.15	4.30	4.45	V
Hysteresis Width		V _{HYS} A	50	100	150	mV
Sagging Detection Voltage	V _{SB} 	V _{SB}	1.212	1.230	1.248	V
	T _a = -40 to +85°C		1.200	1.230	1.260	V
Deviation of Detection Voltage	V _{CC} = 3.5 to 18V	ΔV _{SB}	-	3	10	mV
Hysteresis Width		V _{HYS} B	14	28	42	mV
Input Current	V _{SB} = 5V	I _{IHB}	-	0	250	nA
	V _{SB} = 0V	I _{ILB}	-	20	250	nA
High-Level Output Voltage	I _{RESET} = -5μA, V _{SB} = 5V	V _{OHR}	4.5	4.9	-	V
Output Saturation Voltage	I _{RESET} = 3mA, V _{SB} = 0V	V _{OLR}	-	0.28	0.4	V
	I _{RESET} = 10mA, V _{SB} = 0V		-	0.38	0.5	V
Output Sink Current	V _{OLR} = 1.0V, V _{SB} = 0V	I _{RESET}	20	40	-	mA
C _T Charge Current	V _{SB} = 5V, V _{CT} = 0.5V	I _{CT}	9	12	16	μA

■ ELECTRICAL CHARACTERISTICS (Continued)

DC CHARACTERISTICS

(V_{CC} = 5V, T_a = 25°C)

Parameter	Condition	Symbol	Value			Unit
			Min	Typ	Max	
Input Current	V _{SC} = 5V	I _{IHC}	-	0	500	nA
	V _{SC} = 0V	I _{ILC}	-	50	500	nA
Detection Voltage		V _{SC}	1.225	1.245	1.265	V
	T _a = -40 to +85°C		1.205	1.245	1.285	V
Deviation of Detection Voltage	V _{CC} = 3.5 to 18V	ΔV _{SC}	-	3	10	mV
Output Leakage Current	V _{OHC} = 18V	I _{OHC}	-	0	1	μA
Output Saturation Voltage	I _{OUTC} = 4mA, V _{SC} = 5V	V _{OLC}	-	0.15	0.4	V
Output Sink Current	V _{OLC} = 1.0V, V _{SC} = 5V	I _{OUTC}	6	15	-	mA
Reset Operation Minimum Supply Voltage	V _{OLR} = 0.4V, I _{RESET} = 200μA	V _{CCL}	-	0.8	1.2	V

AC CHARACTERISTICS

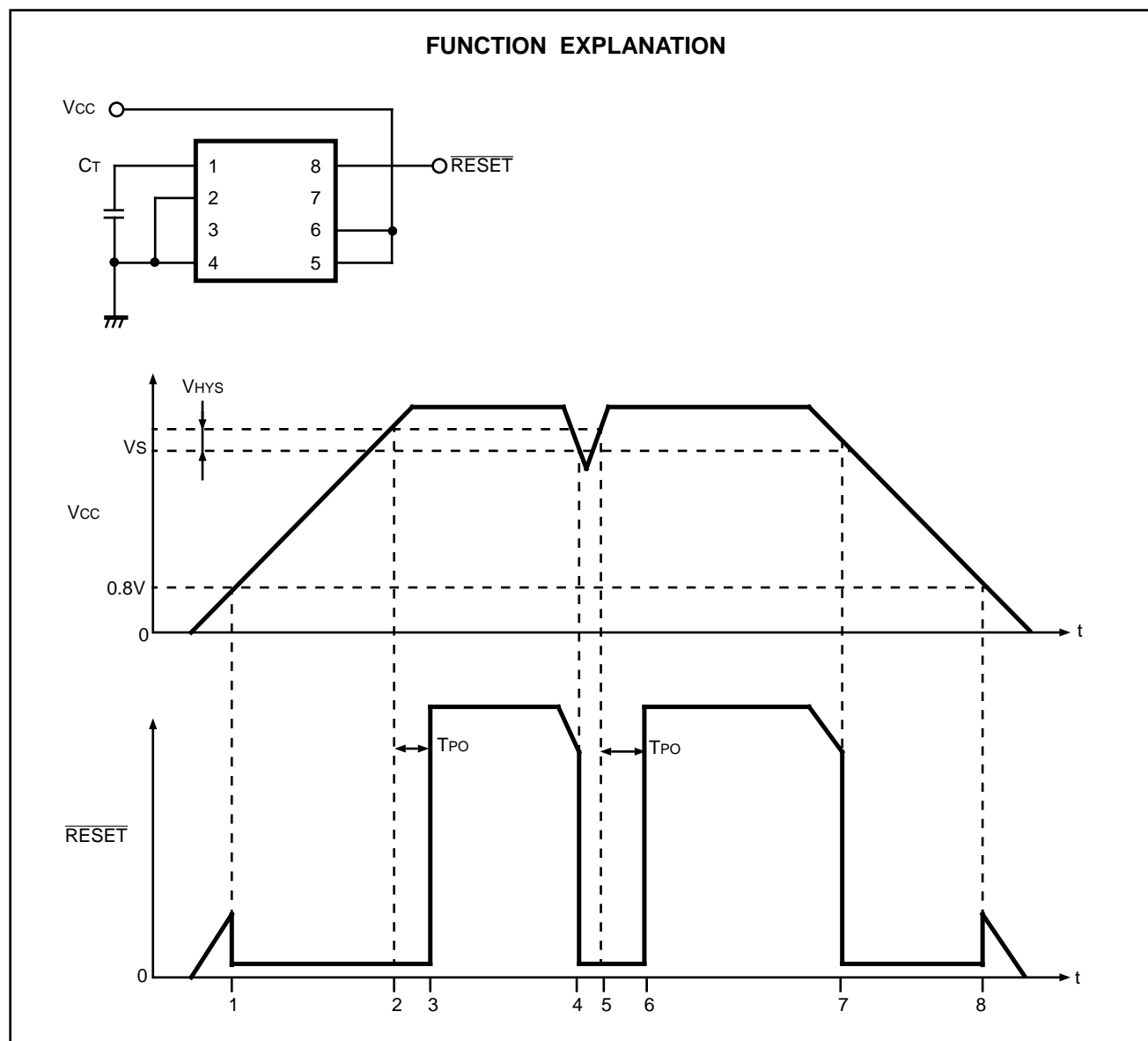
(V_{CC} = 5V, T_a = 25°C C_T = 0.01μF)

Parameter	Condition	Symbol	Value			Unit
			Min	Typ	Max	
Input Pulse Width		t _{PI}	5.0	-	-	μs
RESET Output Pulse Width		t _{PO}	0.5	1.0	1.5	ms
RESET Rising Time	R _L = 2.2KΩ, C _L = 100pF	t _R	-	1.0	1.5	μs
RESET Falling Time	R _L = 2.2KΩ, C _L = 100pF	t _F	-	0.1	0.5	μs
Propagation Delay Time		t _{PD *1}	-	2	10	μs
	R _L = 2.2KΩ, C _L = 100p	t _{PHL *2}	-	0.5	-	μs
	R _L = 2.2KΩ, C _L = 100pF	t _{PLH *2}	-	1.0	-	μs

Note: *1 In case of V_{SB} termination.

*2 In case of V_{SC} termination

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Point 1: When VCC rises to about 0.8V, $\overline{\text{RESET}}$ goes low.

Point 2: When VCC reaches $V_S + V_{HYS}$, C_T then begins charging. $\overline{\text{RESET}}$ remains low during this time.

Point 3: $\overline{\text{RESET}}$ goes high when C_T begins charging.

$$T_{Po} [\text{ms}] \approx 100 \times C_T [\mu\text{F}]$$

Point 4: When VCC level drops lower than V_S , then $\overline{\text{RESET}}$ goes low and C_T starts discharging.

Point 5: When VCC level reaches $V_S + V_{HYS}$, then C_T starts charging

In the case of voltage sagging, if the period from the time VCC goes lower than or equal to V_S to the time VCC reaches $V_S + V_{HYS}$ again, is longer than T_{P1} , (as specified in the AC Characteristics), C_T is discharged and charged successively.

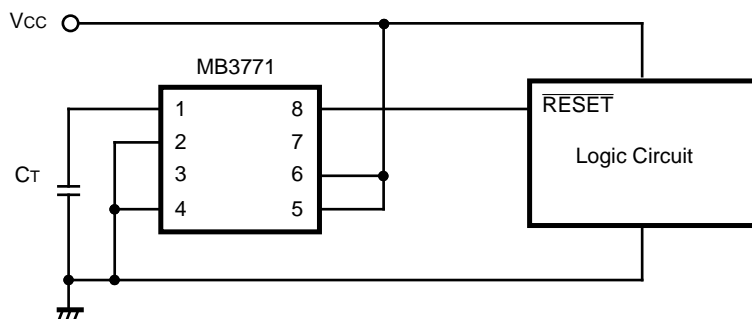
Point 6: After T_{Po} passes, and VCC level exceeds $V_S + V_{HYS}$, then $\overline{\text{RESET}}$ goes high.

Point 7: Same as Point 4.

Point 8: $\overline{\text{RESET}}$ remains low until VCC drops below 0.8V.

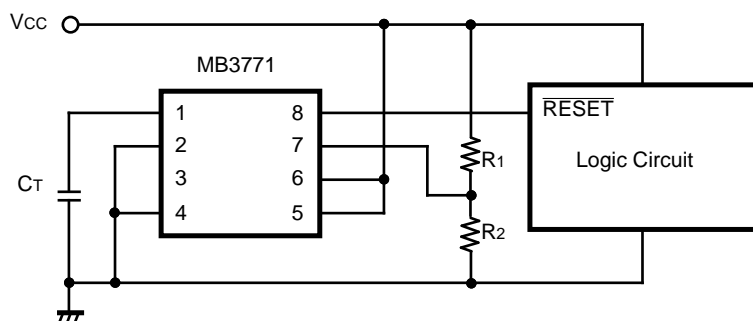
APPLICATION CIRCUIT

EXAMPLE 1: 5V Power Supply Monitor



NOTE: Monitored by VSA. Detection Threshold Voltage is VSAL and VSAH.

EXAMPLE 2: 5V Power Supply Monitor with external adjust



R1 [KΩ]	R2 [KΩ]	Detection Voltage	
		VSAL [V]	VSAH [V]
10	3.9	4.37	4.47
9.1	3.9	4.11	4.20

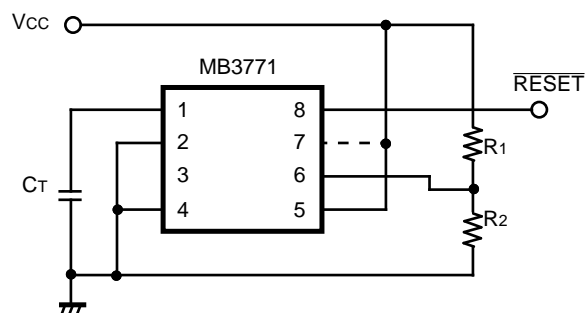
NOTE: Detection voltages can be adjusted as shown below.

EXAMPLE 3: Arbitrary Voltage Supply Monitor

Example 3a: Case: VCC < 18V

- Detection Voltage can be set by R1 and R2.
Detection Voltage = $(R1 + R2) \times V_{SB}/R2$
- Connect Pin 7 to Vcc when Vcc less than 4.45V.
- Pin 7 can be opened when Vcc greater than 4.45V.
Power Dissipation can be reduced.

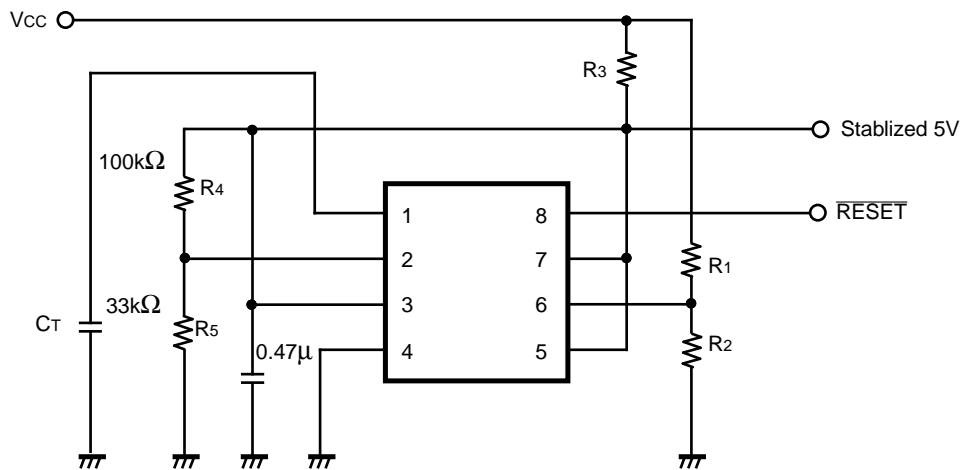
NOTE: Hysteresis of 28mV at VSB at termination is available.
Hysteresis width dose not depend on (R1 + R2).



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EXAMPLE 3: Arbitrary Voltage Supply Monitor

Example 3b: Case: $V_{CC} \geq 18V$

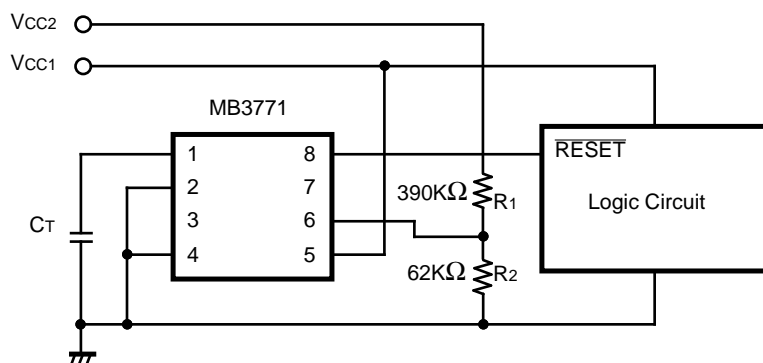


- $\overline{\text{RESET}}$ output levels range from 0V to 1V approximately. Device damage may occur if $\overline{\text{RESET}}$ exceeds its high level (1V).
- Output voltage and maximum $\overline{\text{RESET}}$ voltage levels and determined by resistor R1 and R2.
- In this case, the 5V stabilized output can be used to power TTL circuitry.
- Using the chart below, the value of R3 can be determined with respect to the output current.

VCC [V]	Detection [V]	Min. VCC* for adequate RESET [V]	R1 [MΩ]	R2 [KΩ]	R3 [KΩ]	Output Current [mA]
140	100	6.7	1.6	20	110	< 0.2
100	81	3.8	1.3	20	56	< 0.5
40	33	1.4	0.51	20	11	< 1.6

NOTE: Resistor values are determined when $I_{OUTC} = 100\mu A$, $V_{OLC} = 0.4V$. All resistor are 1/4W.

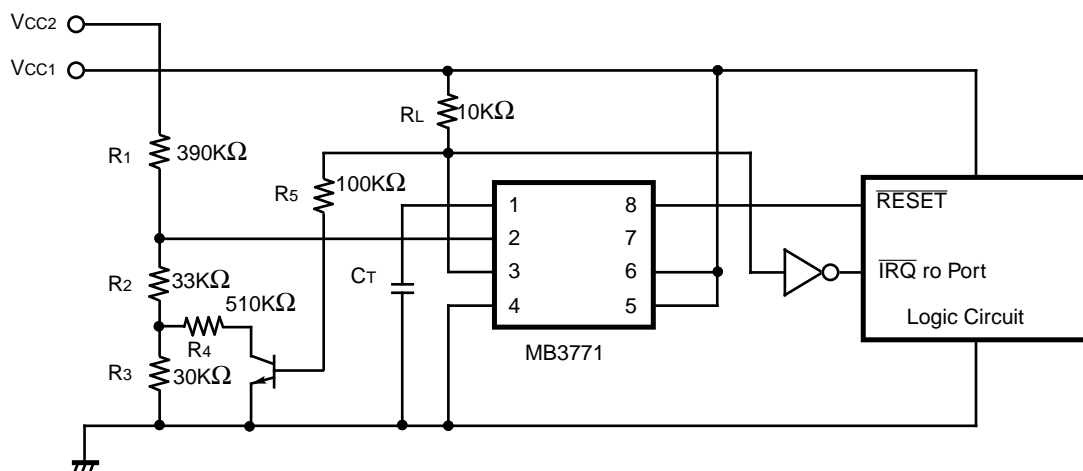
EXAMPLE 4: 5V and 12V Power Supply Monitor ($V_{CC1} = 5V$, $V_{CC2} = 12V$)



NOTE: 5V is monitored by V_{SA} . Detection voltage is about 4.2V.
12V is monitored by V_{SB} . When $R_1 = 390K\Omega$ and $R_2 = 62K\Omega$, Detection voltage is about 9.0V. Generally the detection voltage is determined by the following equation.

$$\text{Detection Voltage} = (R_1 + R_2) \times V_{SB}/R_2$$

EXAMPLE 5: 5V and 12V Power Supply Monitor
 (RESET signal is generated by 5V, VCC1 = 5V, VCC2 = 12V)



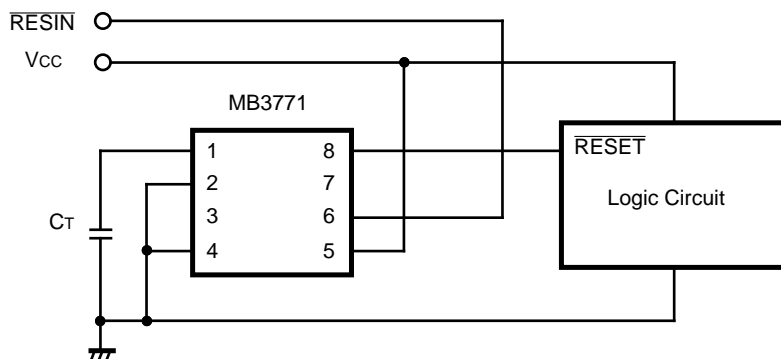
NOTE: 5V is monitored by VSA, and generates $\overline{\text{RESET}}$ signal when VSA detects voltage sagging. 12V is monitored by VSC, and generates its detection signal at OUTC.

The detection voltage of 12V monitoring and its hysteresis is determined by the following equations.

$$\text{Detection voltage} = \frac{R_1 + R_2 + R_3}{R_2 + R_3} \times V_{SC} \text{ (8.95 volts in the circuit above)}$$

$$\text{Hysteresis width} = \frac{R_1 (R_3 - R_3 // R_4)}{(R_2 + R_3) (R_2 + R_3 // R_4)} \times V_{SC} \text{ (200mV in the circuit above)}$$

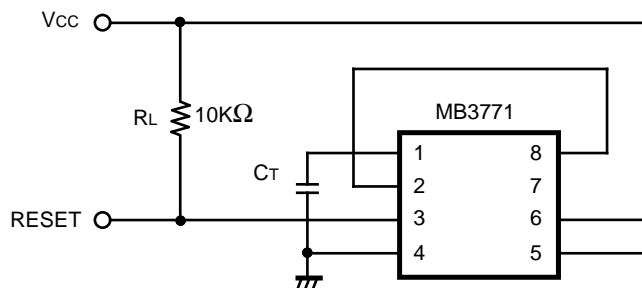
EXAMPLE 6: 5V Power Supply Monitor with forced $\overline{\text{RESET}}$ input



NOTE: $\overline{\text{RESIN}}$ is an TTL compatible input.

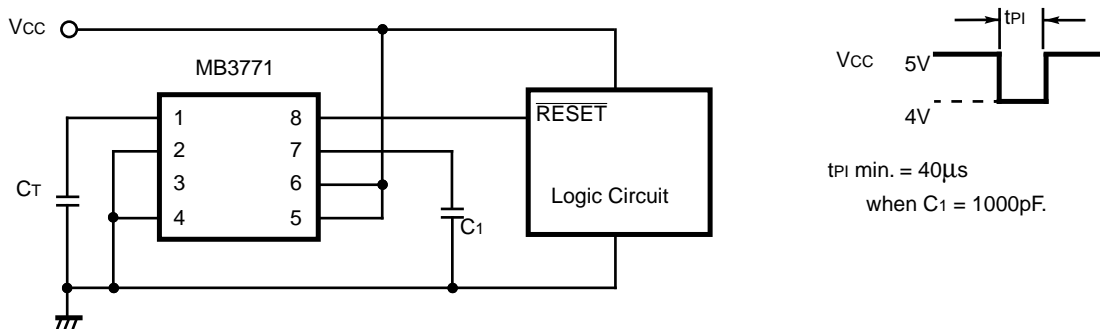
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EXAMPLE 7: 5V Power Supply Monitor with Non-inverted RESET

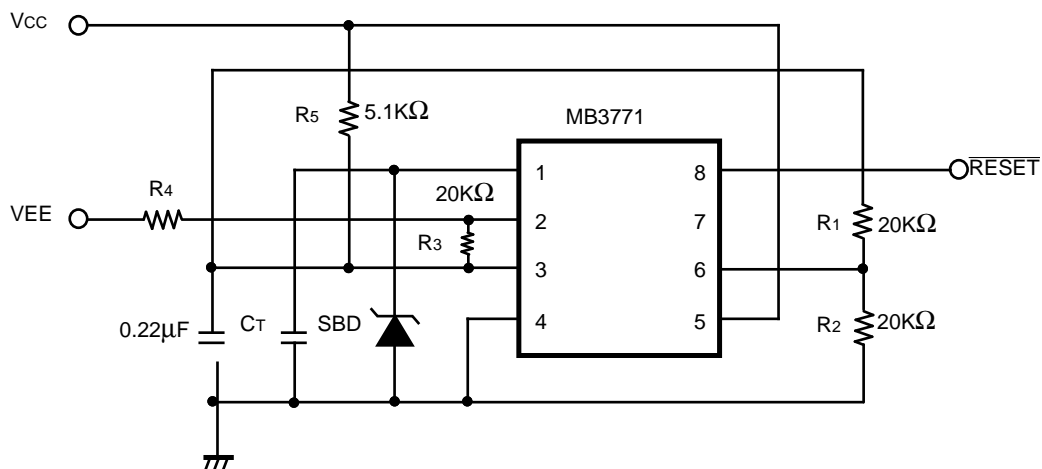


NOTE: In this case, Comparator C is used to invert $\overline{\text{RESET}}$ signal. OUTc is an open-collector output. RL is used as a pull-up resistor.

EXAMPLE 8: 5V Power Supply Monitor with delayed trigger



EXAMPLE 9: 5V and Arbitrary Negative Voltage Monitor



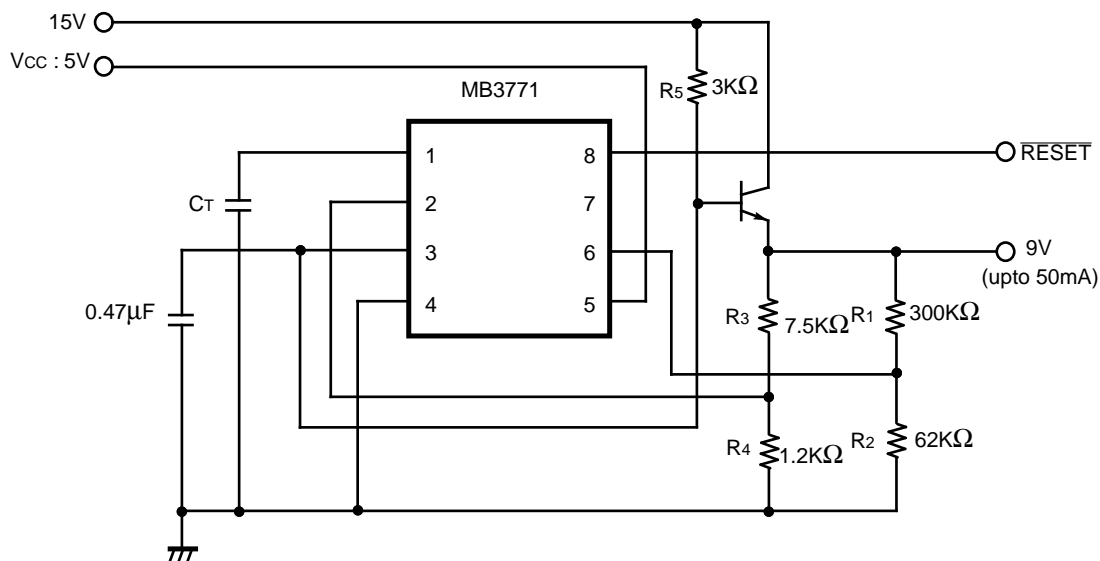
NOTE: +5V and negative voltage are monitored at Vcc and VEE respectively. R1, R2, and R3 should be the same value. The negative detection voltages is determined by as the following equation.

$$\text{Detection Voltage } V_s = V_{SB} - V_{SB} \cdot R_4 / R_3$$

Example: When $V_{EE} = -5\text{V}$ and $R_4 = 91\text{K}\Omega$, $V_s = -4.37\text{V}$.

EXAMPLE 10: Reference Voltage Generation and Voltage Sagging Detection

Example 10a: 9V Reference Voltage Generation and 5V/9V Monitoring

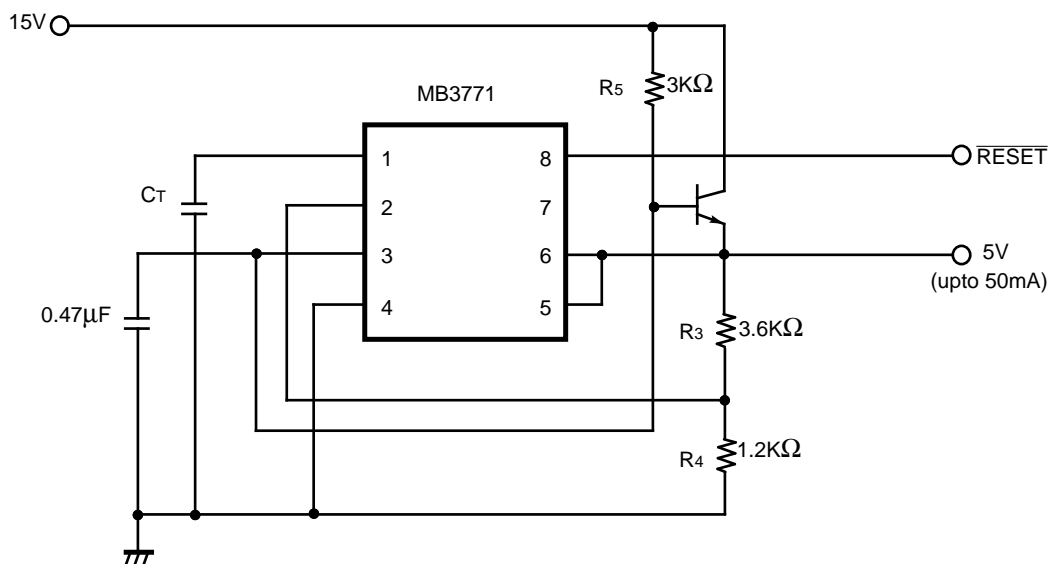
NOTE: Detection Voltage: $V_s = 7.2V, 4.2V$

In the above examples, the output voltage and the detection voltage are determined by the following equations:

Output Voltage: $V_o = (R_3 + R_4) \cdot V_{sc}/R_4$

Detection Voltage: $V_s = (R_1 + R_2) \cdot V_{SB}/R_2$

Example 10b: 5V Reference Voltage Generation and 5V Monitoring

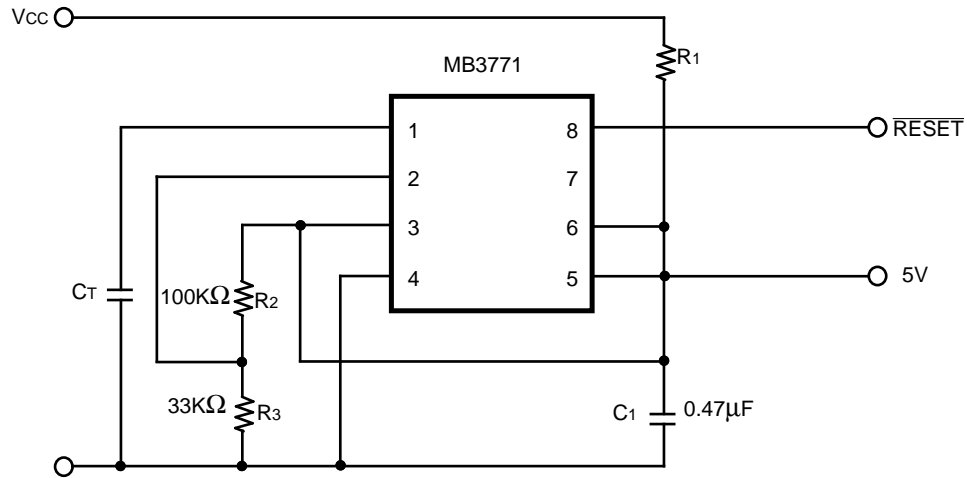
NOTE: Detection Voltage: $V_s = 4.2V$

In the above examples, the output voltage is determined by the following equations:

Output Voltage: $V_o = (R_3 + R_4) \cdot V_{sc}/R_4$

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Example 10c: 5V Reference Voltage Generation and 5V Monitoring



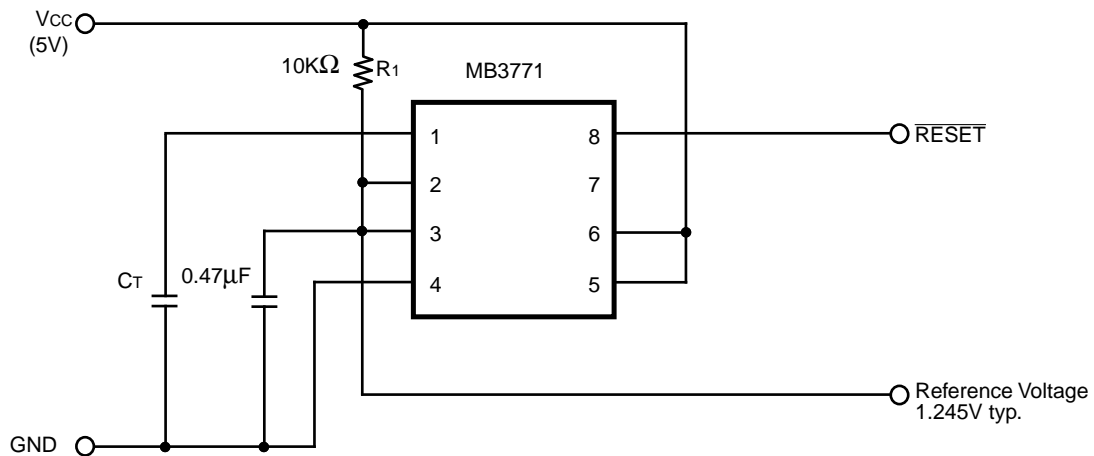
Using the reference table below, the value of R1 can be determined.

Where R2 is 100KΩ, R3 is 33KΩ, C1 is 0.47μF

Reference Table of R1, Vcc and the output current.

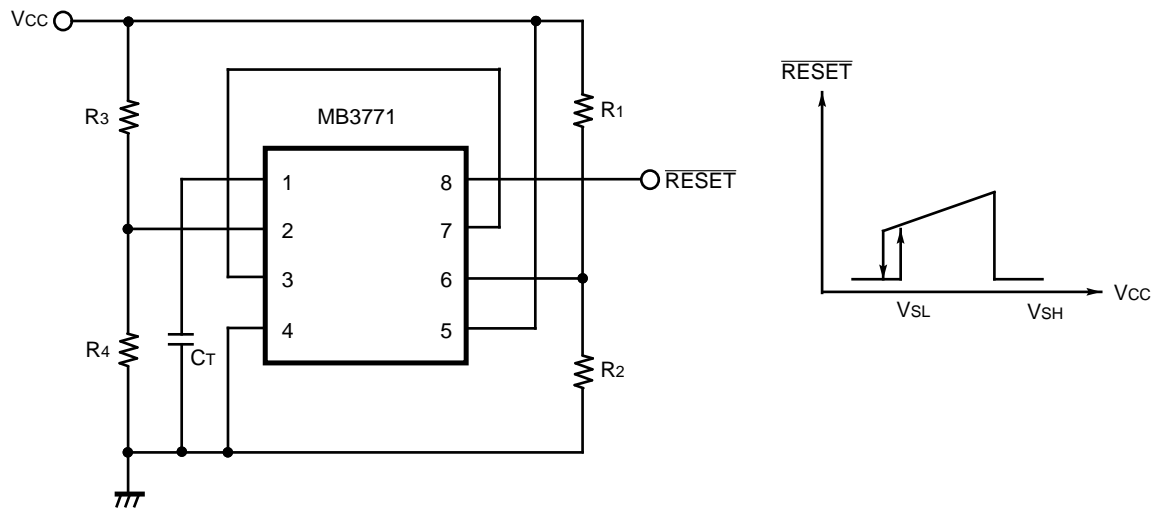
Vcc [V]	R1 [KΩ]	Output Current [mA]
40	11	< 1.6
24	6.2	< 1.4
145	4.7	< 0.6

Example 10d: 1.245V Reference Voltage Generation and 5V Monitoring



NOTE: Resistor R1 determines Reference current. Using 1.2KΩ as R1, reference current is about 2mA.

EXAMPLE 11: Low Voltage and Over Voltage Detection



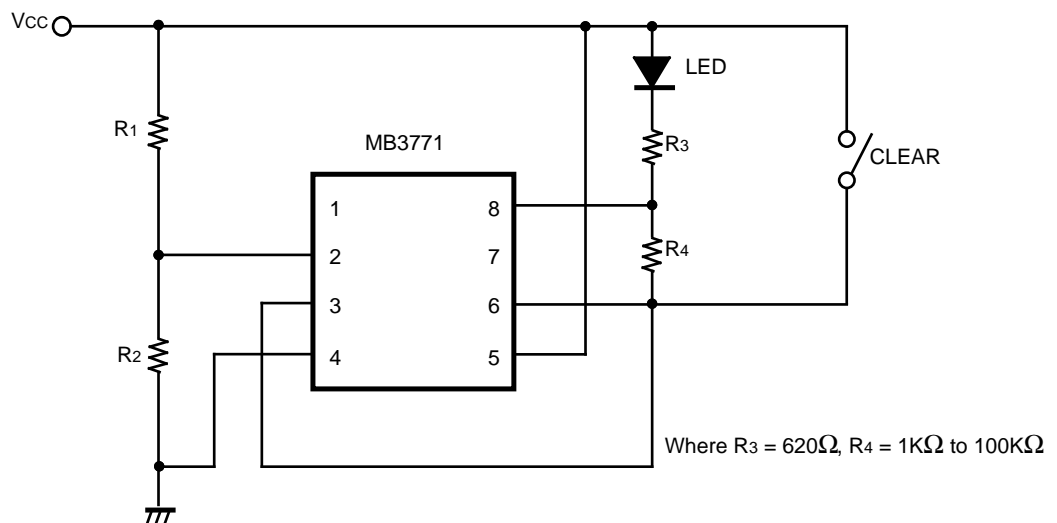
NOTE: V_{SH} has no hysteresis. When over voltage is detected, \overline{RESET} is held in the constant time as well as when low voltage is detected.

$$V_{SL} = (R1 + R2) \times V_{SB}/R2$$

$$V_{SH} = (R3 + R4) \times V_{SC}/R4$$

EXAMPLE 12: Detection of Abnormal State of Power Supply System

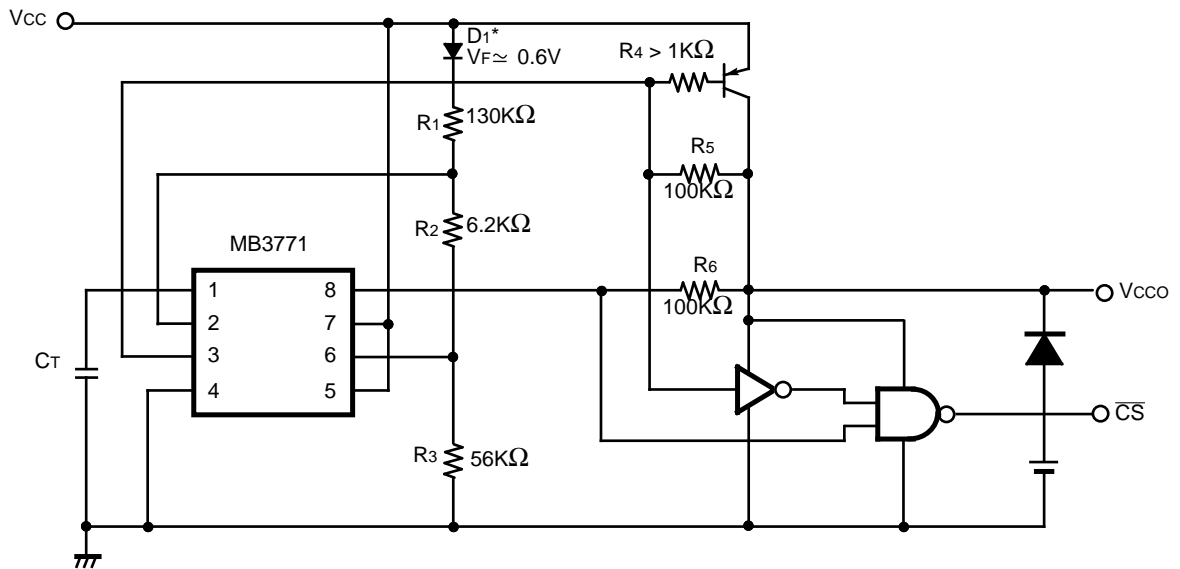
This Example circuit detects abnormal low/over voltage of power supply voltage and is indicated by LED indicator. LED is reset by the CLEAR key.



NOTE: The detection levels of low/over voltages are determined by V_{SA} , and $R1$ and $R2$ respectively.

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EXAMPLE 13: Back-up Power Supply System (Vcc = 5V)



* : Diode has been added to prevent Comp.C from malfunctioning when Vcc voltage is low.
Set V1 and V2 with care given to VF temperature characteristics (typically negative temperature characteristics).

NOTE: Use CMOS Logic and connect VDD of CMOS logic with Vcco.

The back-up battery works after \overline{CS} goes high as $V_2 < V_1$.
During tPO, memory access is prohibited.
CS's threshold voltage V1 is determined by the following equation:

$$V_1 = (R_1 + R_2 + R_3) \times V_{SB} / R_3$$

The voltage to change V2 is provided as the following equation:

$$V_2 = (R_1 + R_2 + R_3) \times V_{SC} / (R_2 + R_3)$$

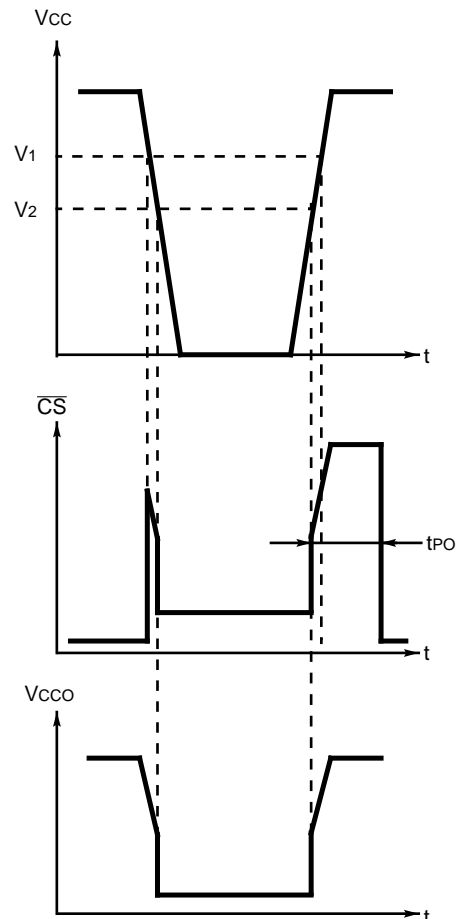


Fig. 1 - Supply Current Icc1 vs. Supply Voltage

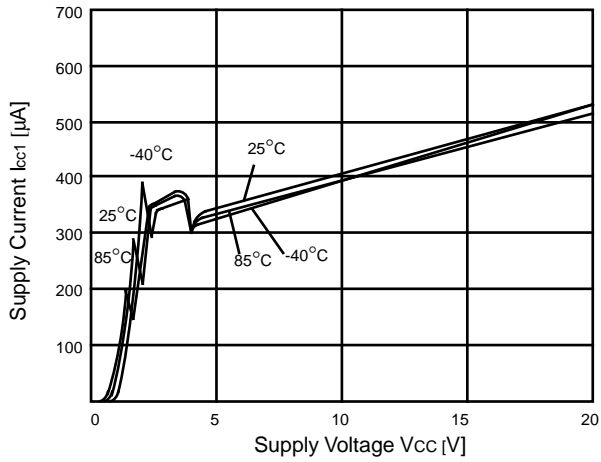


Fig. 2 - Supply Current Icc2 vs. Supply Voltage

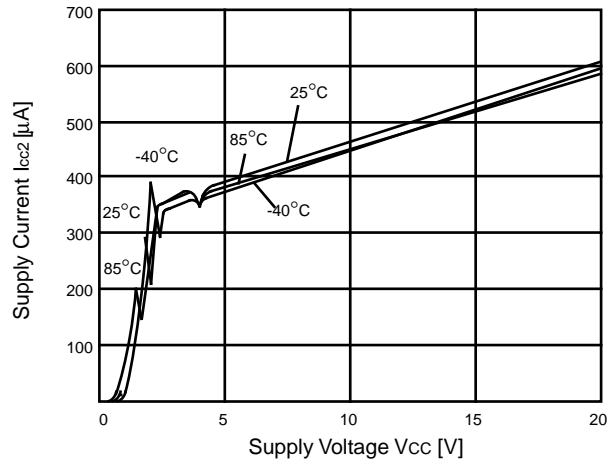


Fig. 3 - Detection Voltage VSA vs. Ambient Temperature

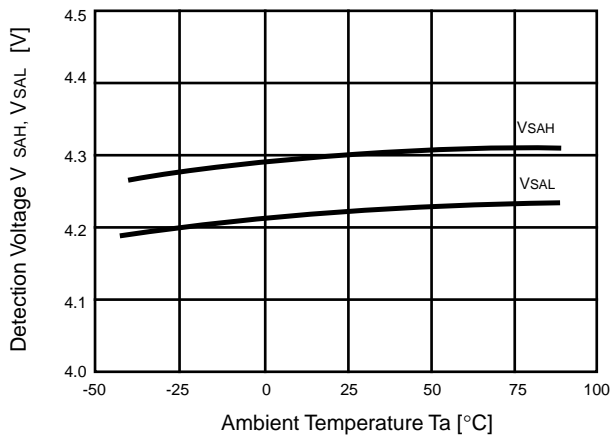


Fig. 4 - Detection Voltage VSB vs. Ambient Temperature

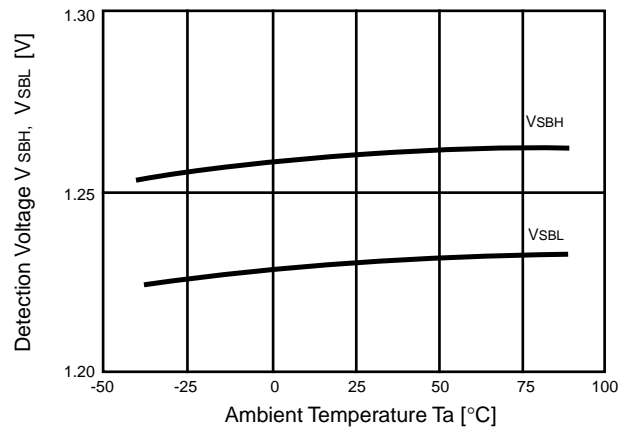


Fig. 5 - Detection Voltage Vsc vs. Ambient Temperature

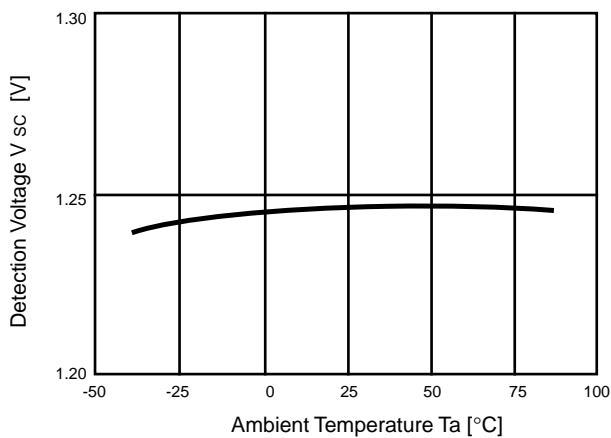
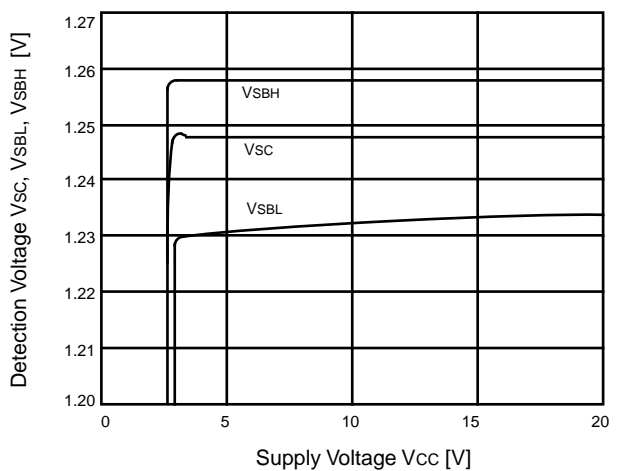


Fig. 6 - Detection Voltage VSB, Vsc vs. Supply Voltage



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Fig. 7 - $\overline{\text{RESET}}$ Output Voltage vs. Supply Voltage

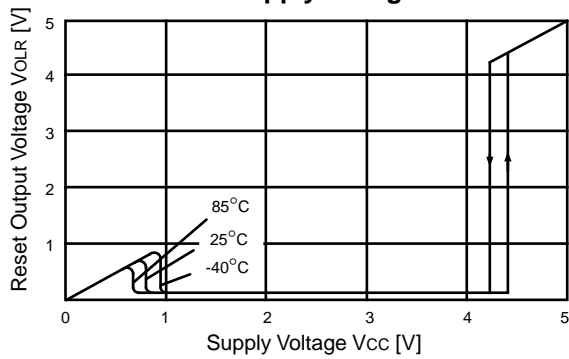


Fig. 8 - $\overline{\text{RESET}}$ High-level Voltage vs. $\overline{\text{RESET}}$ Output Current

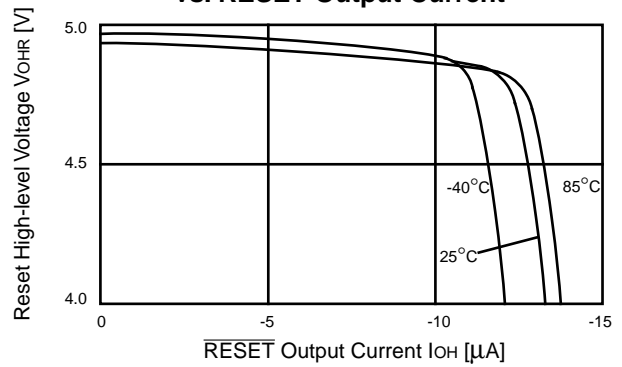


Fig. 9 - $\overline{\text{RESET}}$ Low-level Voltage vs. $\overline{\text{RESET}}$ Output Current

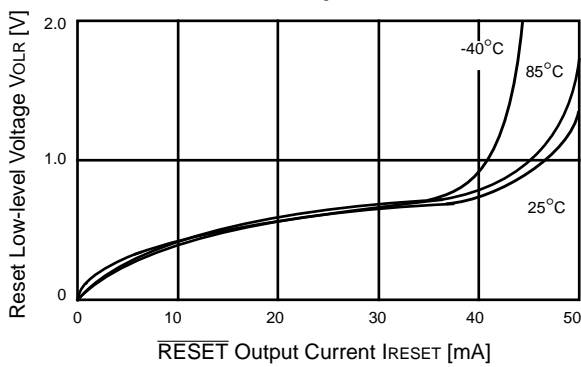


Fig. 10 - OUTc Output Voltage vs. OUTc Output Current

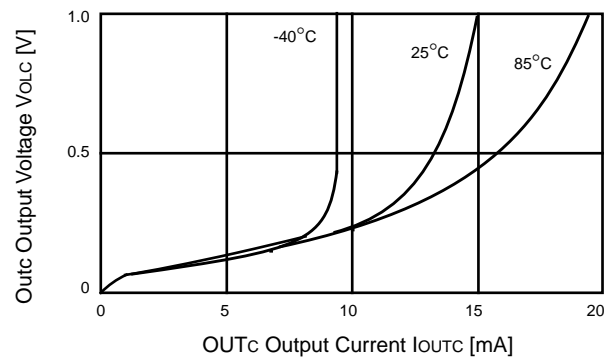


Fig. 11 - CT Capacitance vs. Reset Hold Time

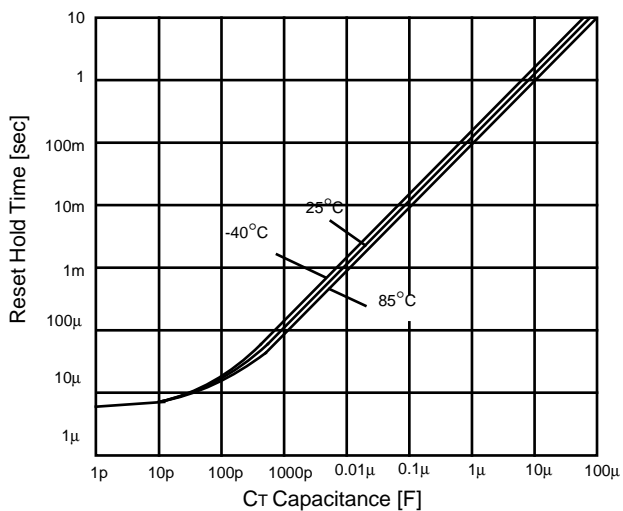
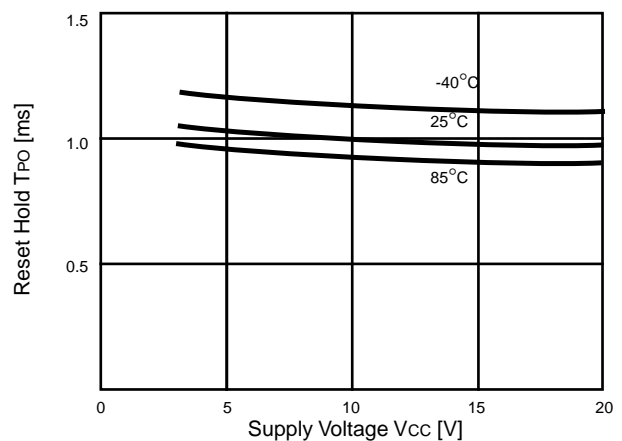
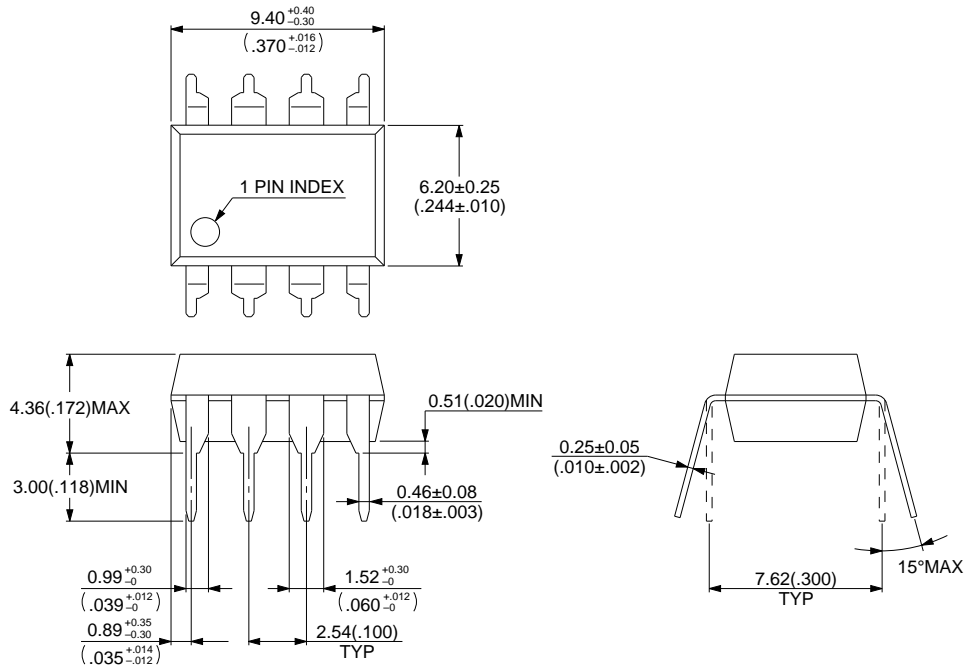


Fig. 12 - Reset Hold Time vs. Supply Voltage (CT = 0.01µF)



■ PACKAGE DIMENSIONS

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



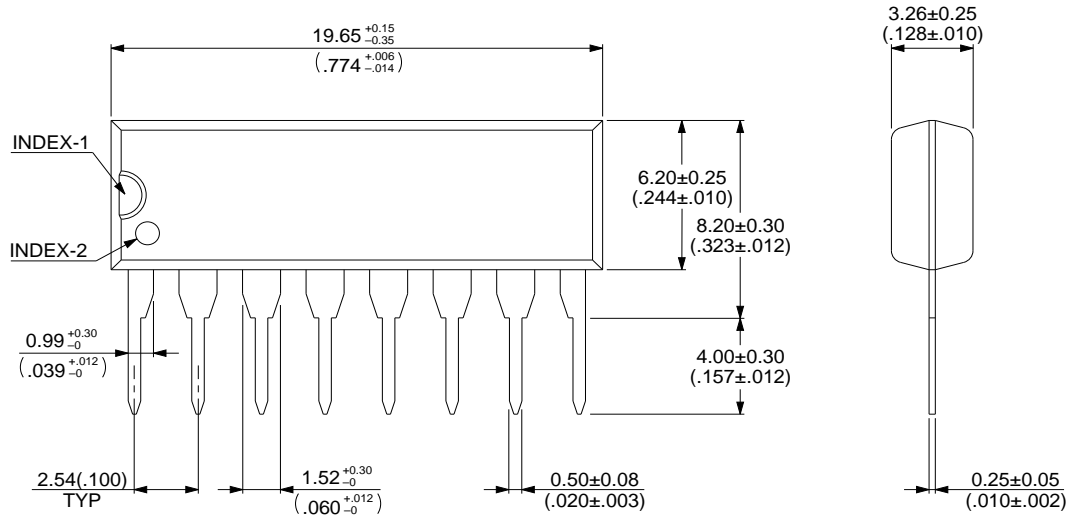
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Dimensions in mm (inches).

MB3771

■ PACKAGE DIMENSIONS (Continued)

8 pin, Plastic SIP
(SIP-8P-M03)

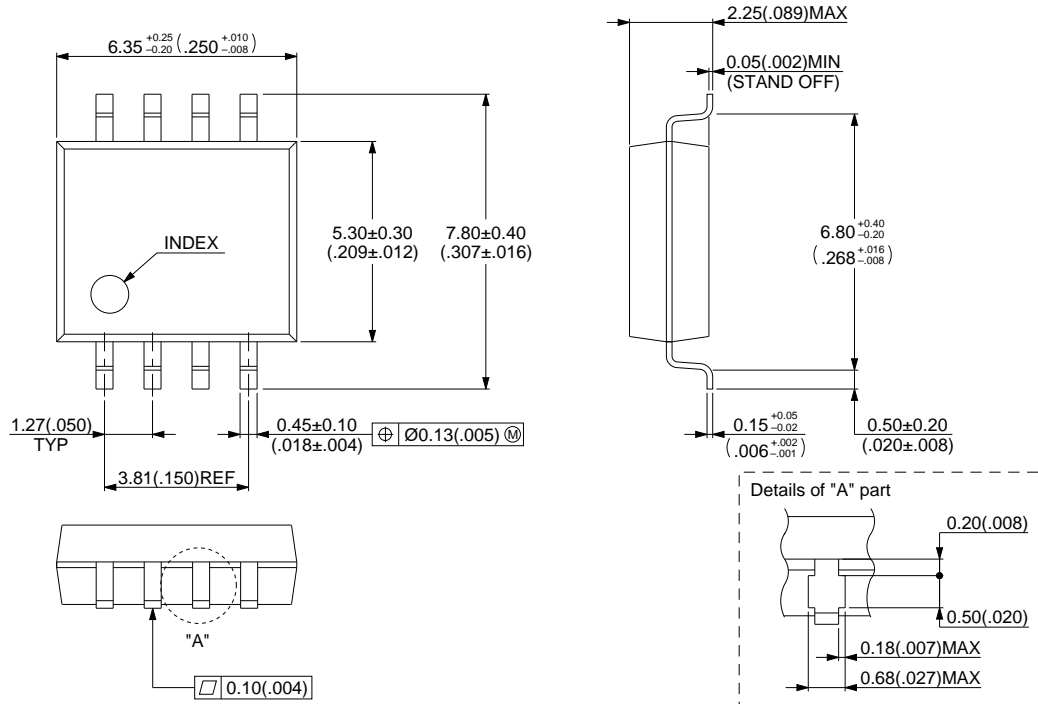


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Dimensions in mm (inches).

■ PACKAGE DIMENSIONS (Continued)

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



Dimensions in mm(inches).

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