

MB3771

POWER SUPPLY MONITOR

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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.

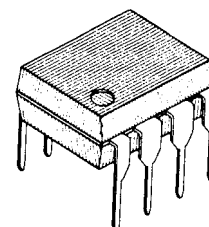
FEATURES

- 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, $\geq 1.23V$)
- 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., $V_{CC} = 5V$)
- Over voltage detection
- 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

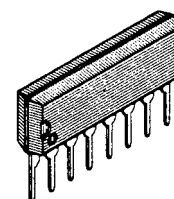
ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	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	P_D	200 ($T_A \leq 85^\circ C$)	mW
Storage Temperature	T_{STG}	-55 to +125	$^\circ C$

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.



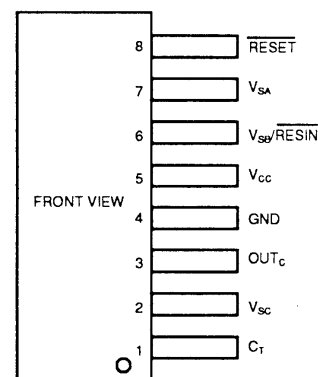
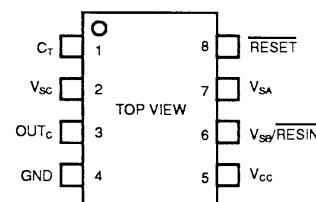
Plastic Package
DIP-08P-M01



Plastic Package
SIP-08P-M03

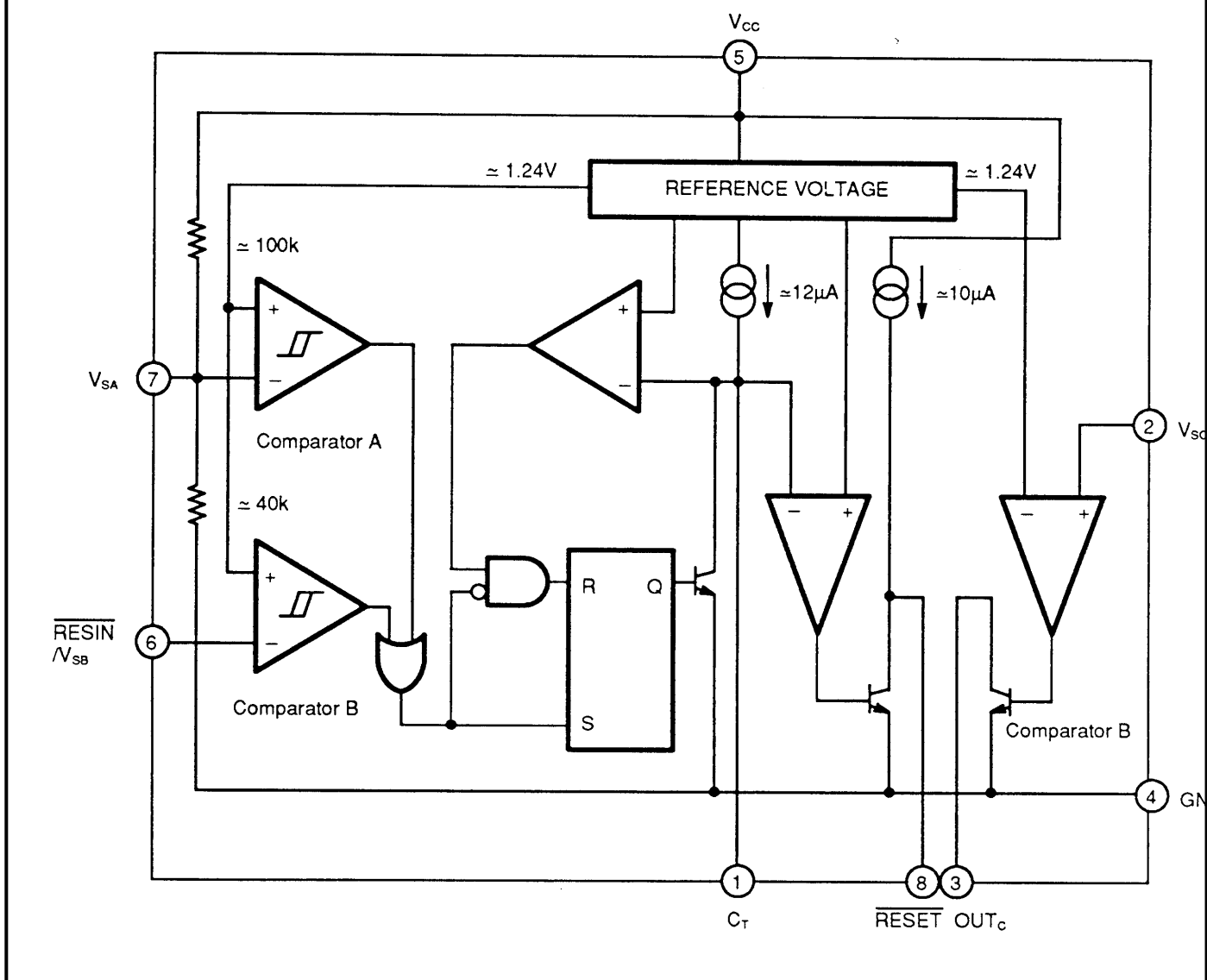
FPT-08P-M01: See page 18

Pin Assignment



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.

MB3771 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, the \overline{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 μ s 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).


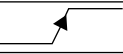

Internal pull-up resistor on the $\overline{\text{RESET}}$ line provides for high impedance loading (i.e. CMOS logic).

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	+3.5 to +18	V
Output Current ($\overline{\text{RESET}}$)	I_{RESET}	0 to 20	mA
Output Current (OUT_C)	I_{OUTC}	0 to 6	mA
Operating Ambient Temperature	T_A	-40 to +85	°C

ELECTRICAL CHARACTERISTICS

DC Characteristics ($V_{CC} = 5V$, $T_A = 25^\circ\text{C}$)

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
	V_{SB} , $T_A = -40$ to $+85^\circ\text{C}$		4.05	4.20	4.30	V
Rising	V_{CC} 	V_{SAH}	4.20	4.30	4.40	V
	V_{CC} , $T_A = -40$ to 85°C		4.15	4.30	4.45	V
Hysteresis Width		V_{HYSA}	50	100	150	mV
Sagging Detection Voltage	V_{SB} 	V_{SB}	1.212	1.230	1.248	V
	V_{SB} , $T_A = -40$ 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_{HYSB}	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	$I_{\text{RESET}} = -5\mu\text{A}$, $V_{SB} = 5V$	V_{OHR}	4.5	4.9		V
Output Saturation Voltage	$I_{\text{RESET}} = 3\text{mA}$, $V_{SB} = 0V$	V_{OLR}		0.28	0.4	V
	$I_{\text{RESET}} = 10\text{mA}$, $V_{SB} = 0V$			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 ($V_{CC} = 5V$, $T_A = 25^\circ C$)

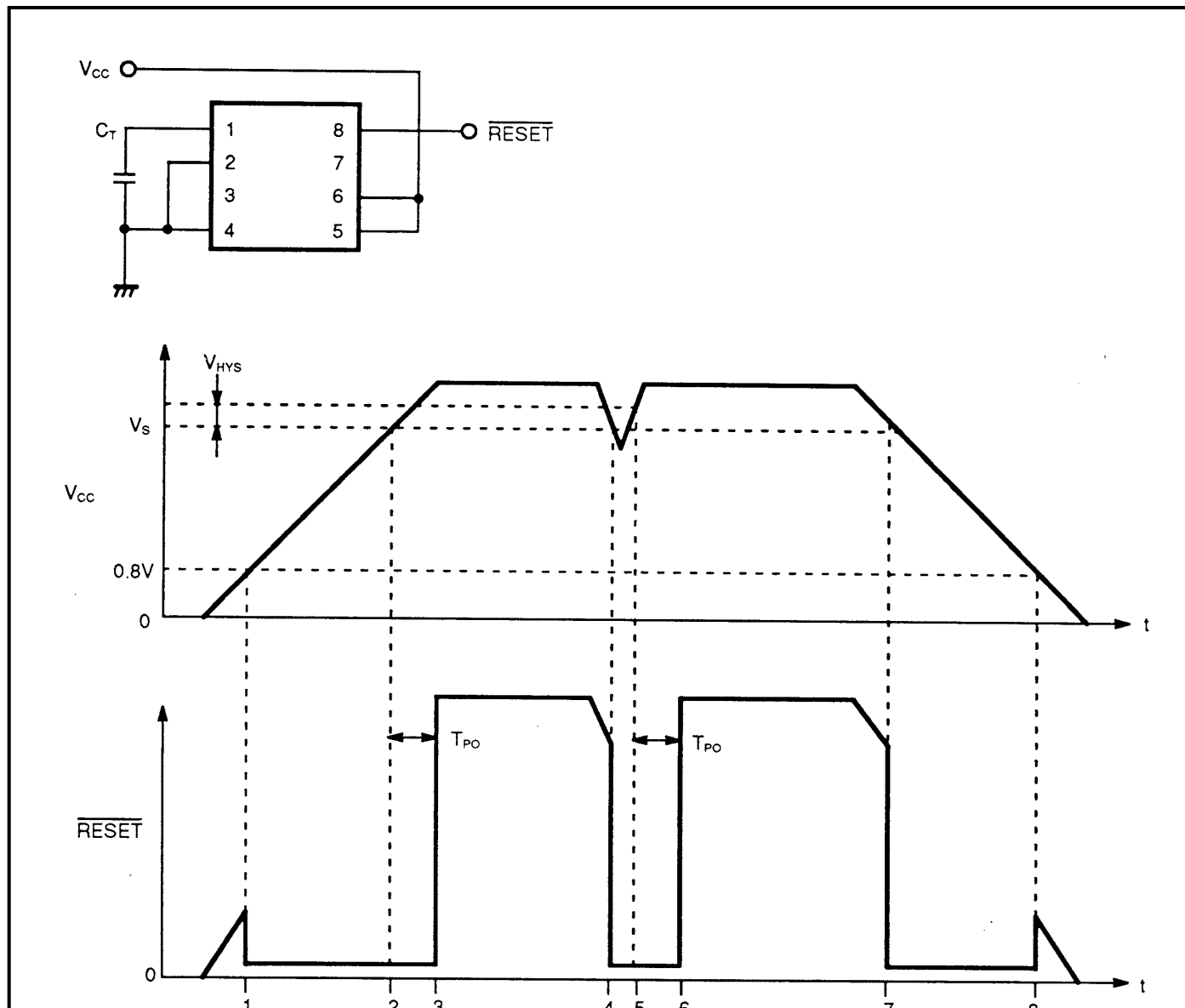
Parameter	Condition	Symbol	Value			Unit
			Min	Typ	Max	
Input Current	$V_{SC} = 5V$	I_{IHC}		0	500	nA
	$V_{SC} = 0V$	I_{ILC}		50	500	nA
Detection Voltage	V_{SC}	V_{SC}	1.225	1.245	1.265	V
	V_{SC} , $T_A = -40$ to $+85^\circ C$		1.205	1.245	1.285	V
Deviation of Detection Voltage	$V_{CC} = 3.5$ to $18V$	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	$V_{OLR} = 0.4V$, $I_{RESET} = 200\mu A$	V_{CCL}		0.8	1.2	V

AC Characteristics ($V_{CC} = 5V$, $T_A = 25^\circ C$, $C_T = 0.01\mu F$)

Parameter	Condition	Symbol	Value			Unit
			Min	Typ	Max	
Input Pulse Width	V_{SA} , V_{SB}	t_{PI}	5.0			μs
RESET Output Pulse Width		t_{PO}	0.5	1.0	1.5	ms
RESET Rising Time	$R_L = 2.2k\Omega$, $C_L = 100pF$	t_R		1.0	1.5	μs
RESET Falling Time	$R_L = 2.2k\Omega$, $C_L = 100pF$	t_F		0.1	0.5	μs
Propagation Delay Time	V_{SB}	t_{PD}^{*1}		2	10	μs
	V_{SC} , $R_L = 2.2k\Omega$, $C_L = 100pF$	t_{PHL}^{*2}		0.5		μs
	V_{SC} , $R_L = 2.2k\Omega$, $C_L = 100pF$	t_{PLH}^{*2}		1.0		μs

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

*2 In case of V_{SC} termination



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

Point 2: When V_{CC} 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.

$$T_{OP} \approx C_T \times 10^5 [\text{ms}]$$

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

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

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

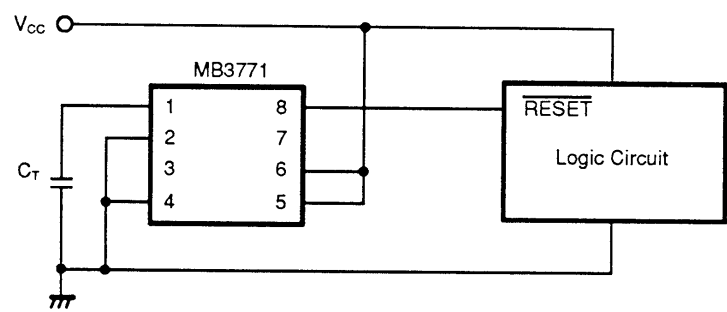
Point 6: After T_{PO} passes, and V_{CC} level exceeds $V_S + V_{HYS}$, then $\overline{\text{RESET}}$ goes high.

Point 7: Same as Point 4.

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

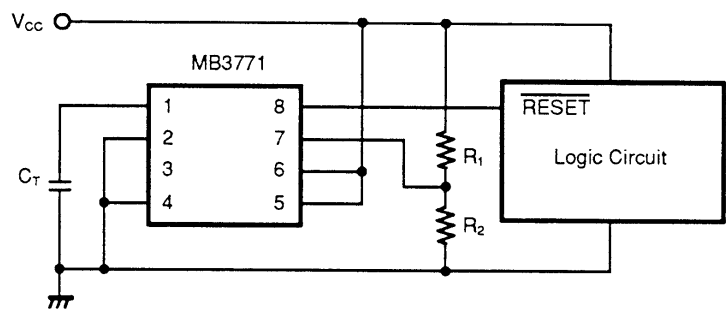
APPLICATION CIRCUIT

EXAMPLE 1: 5V Power Supply Monitor



NOTE: Monitored by V_{SA}. Detection Threshold Voltage is V_{SAL} and V_{SAH}.

EXAMPLE 2: 5V Power Supply Monitor with external adjust



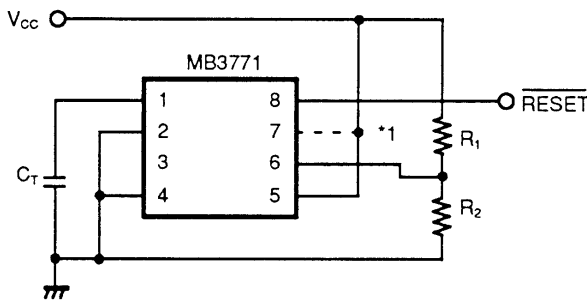
R ₁ [kΩ]	R ₂ [kΩ]	Detection Voltage	
		V _{SAL} [V]	V _{SAH} [V]
10	3.9	4.37	4.47
9.1	3.9	4.11	4.20

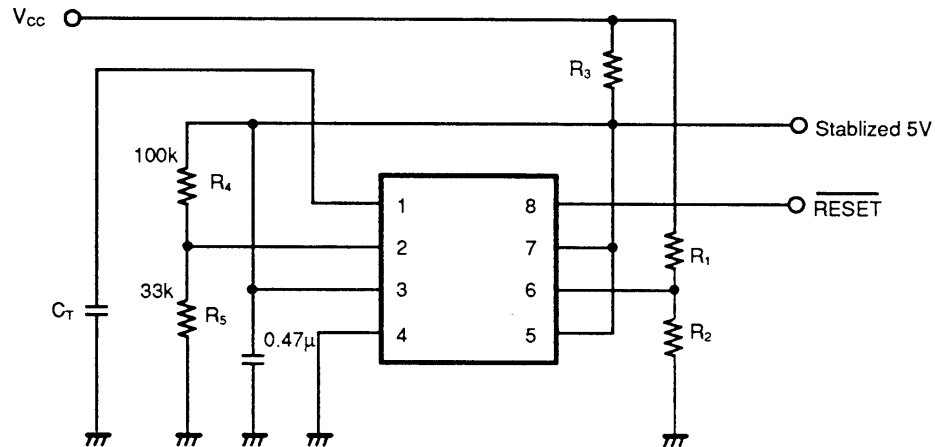
NOTE: Detection voltages can be adjusted as shown below.

EXAMPLE 3: Arbitrary Voltage Supply Monitor
Example 3a: Case: V_{CC} < 18V

- Detection Voltage can be set by R₁ and R₂.
 $(R_1 + R_2) \times V_{SB}/R_2$
- Connect Pin 7 to V_{CC} when V_{CC} less than 4.45V.
- Pin 7 can be opened when V_{CC} greater than 4.45V. Power Dissipation can be reduced.

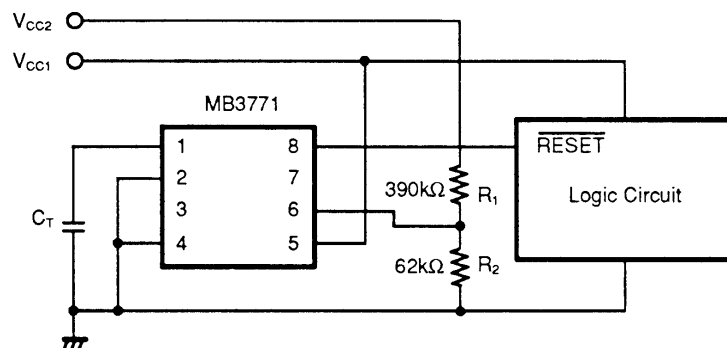
NOTE: Hysteresis of 28mV at V_{SB} at termination is available. Hysteresis width dose not depend on (R₁ + R₂).



EXAMPLE 3: Arbitrary Voltage Supply MonitorExample 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 are determined by resistor R_1 and R_2 .
- In this case, the 5V stabilized output can be used to power TTL circuitry.
- Using the chart below, the value of R_3 can be determined with respect to the output current.

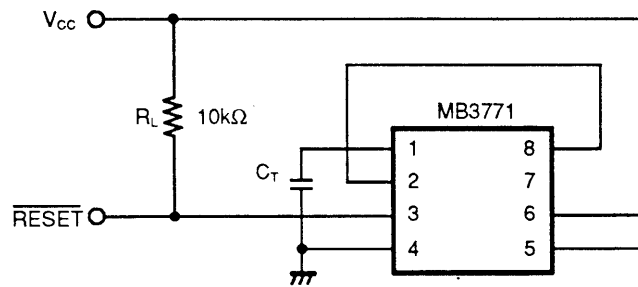
V_{CC} [V]	Detection Voltage [V]	Min. V_{CC}^* for adequate $\overline{\text{RESET}}$ [V]	R_1 [M Ω]	R_2 [k Ω]	R_3 [k Ω]	Output Current [mA]
140	100	6.7	1.6	20	110	< 0.2
100	81	3.8	1.3	20	56	< 0.5
40	33	1.4	0.51	20	11	< 1.6

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

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

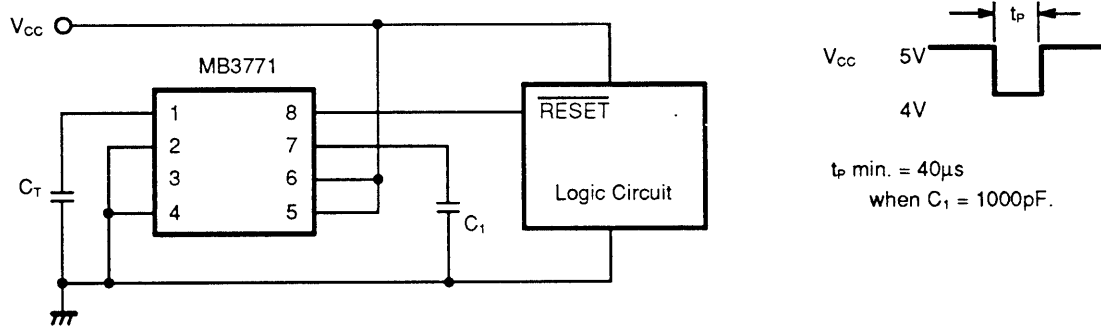
NOTE: RESIN is an TTL compatible input.

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

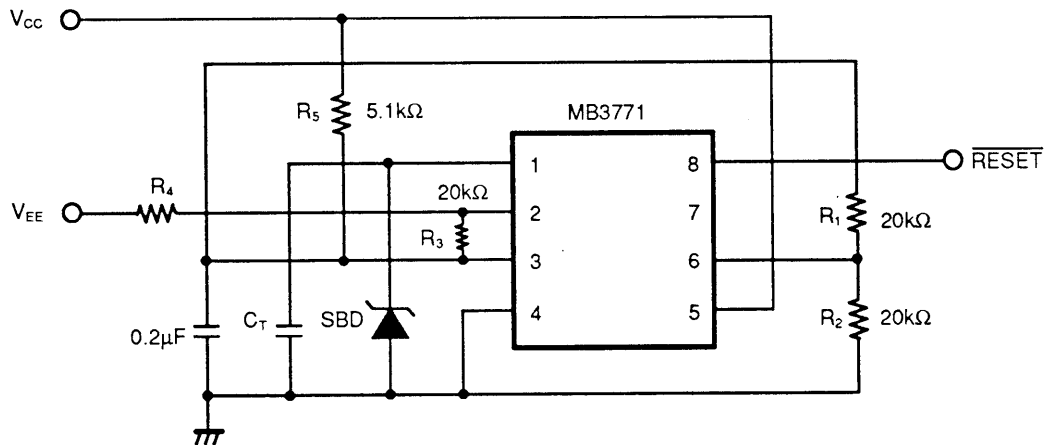


NOTE: In this case, Comparator C is used to invert $\overline{\text{RESET}}$ signal. OUT_C is an open-collector output. R_L is used as a pull-up resistor.

EXAMPLE 8: 5V Power Supply Monitor with delayed trigger



EXAMPLE 9: 5V and Arbitrary Negative Voltage Monitor



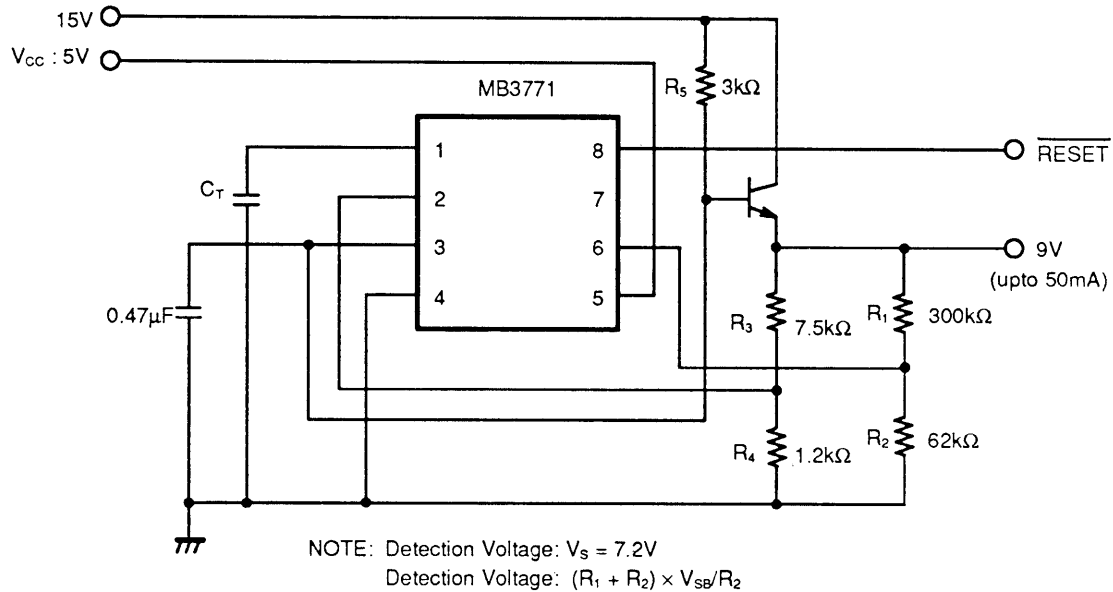
NOTE: +5V and negative voltage are monitored at V_{CC} and V_{EE} respectively. R_1 , R_2 , and R_3 should be the same value. The negative detection voltage is determined by as the following equation.

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

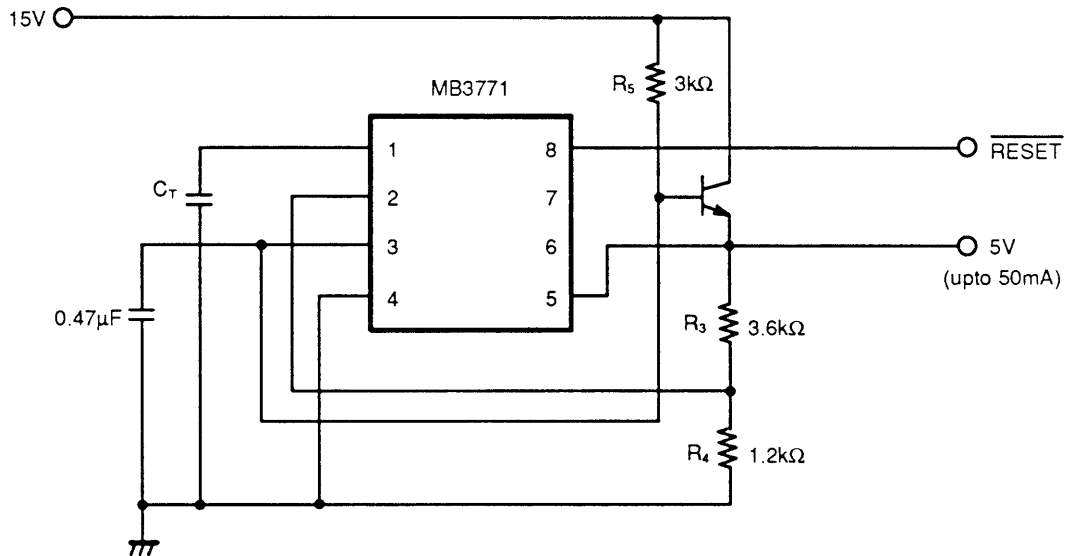
Example: When $V_{EE} = -5\text{V}$ and $R_4 = 91\text{k}\Omega$, $V_S = -4.37\text{V}$.

EXAMPLE 10: Reference Voltage Generation and Voltage Sagging Detection

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



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



NOTE: Detection Voltage: $V_S = 4.2V$
 In the above examples, the output voltage and the detection voltage are determined by the following equations:
 Output Voltage: $V_O = (R_3 + R_4) \times V_{SC}/R_4$
 Detection Voltage: $V_S = (R_1 + R_2) \times V_{SB}/R_2$

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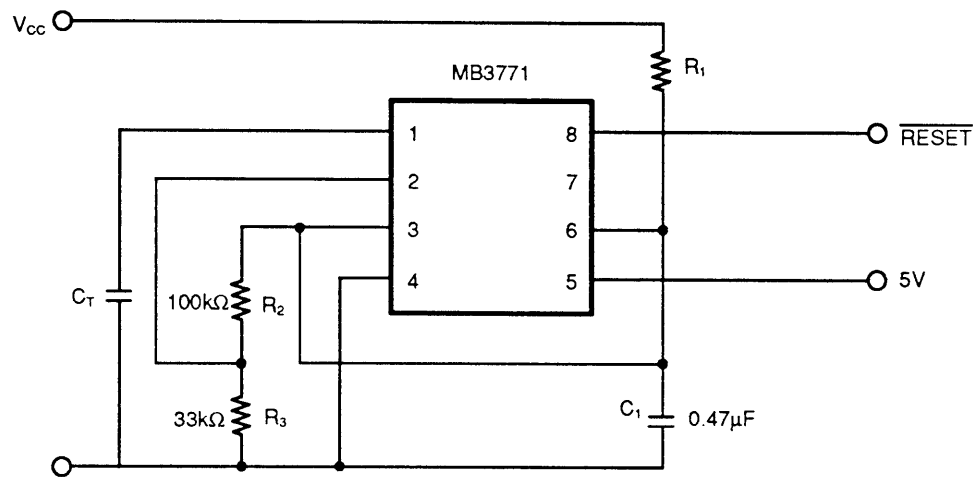
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PACKAGE DIMENSIONS

PACKAGE DIMENSIONS (Continued)

PACKAGE DIMENSIONS (Continued)

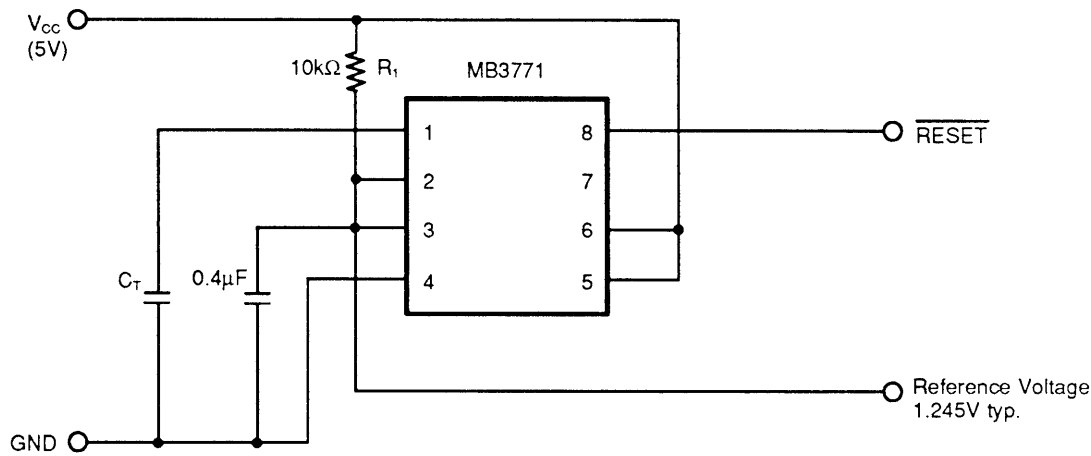
Example 10c: 5V Reference Voltage Generation and 5V Monitoring



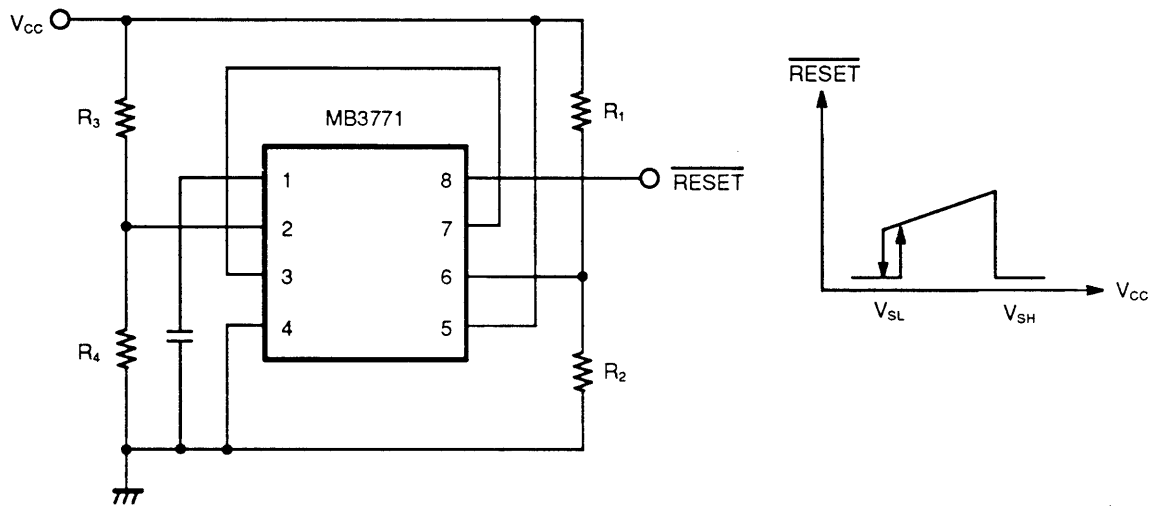
Using the reference table below, the value of R_1 can be determined. Where R_2 is $100\text{k}\Omega$, R_3 is $33\text{k}\Omega$, C_1 is $0.47\mu\text{F}$.

Reference Table of R_1 , V_{cc} , and the output current		
V_{cc} [V]	R_1 [$\text{k}\Omega$]	Output Current [mA]
40	11	< 1.6
24	6.2	< 1.4
15	4.7	< 0.6

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



NOTE: Resistor R_1 determines Reference current. Using $1.2\text{k}\Omega$ as R_1 , reference current is about 2mA.

EXAMPLE 11: Low Voltage and Over Voltage Detection

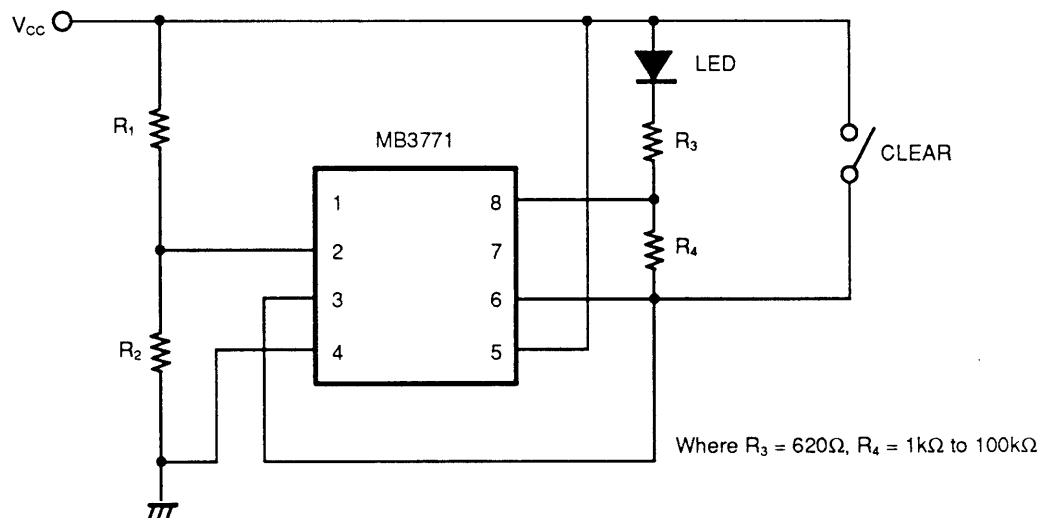
NOTE: V_{SH} has no hysteresis. When over voltage is detected, $\overline{\text{RESET}}$ is held in the constant time as well as when low voltage is detected.

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

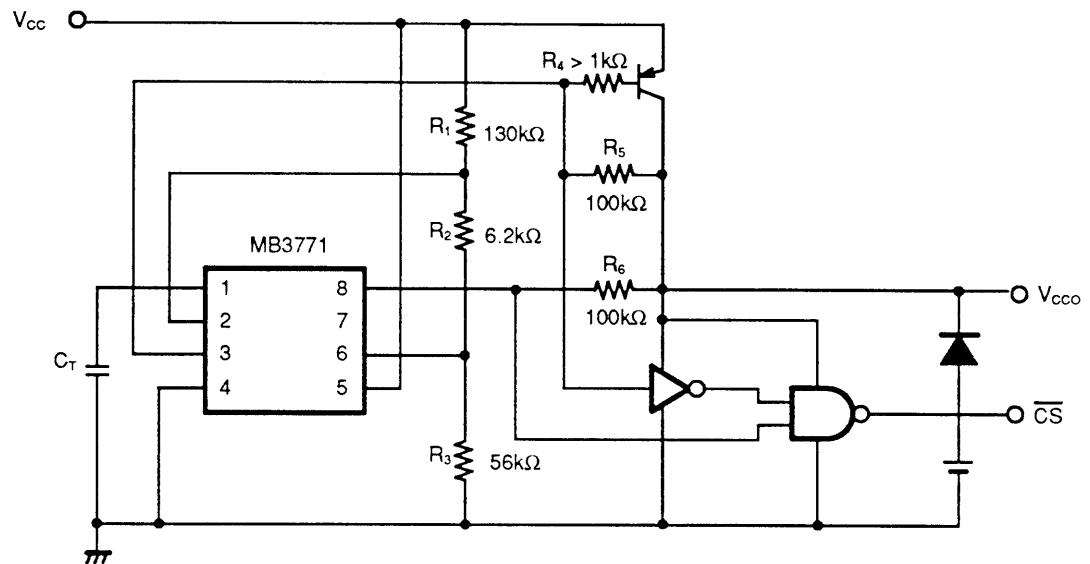
$$V_{SH} = (R_3 + R_4) \times V_{SC}/R_4$$

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.

EXAMPLE 13: Back-up Power Supply System ($V_{CC} = 5V$)

NOTE: Use CMOS Logic and connect V_{DD} of CMOS logic with V_{CCO} .

The back-up battery works after \overline{CS} goes high as $V_2 < V_1$.

During t_{PO} , memory access is prohibited.

\overline{CS} 's threshold voltage V_1 is determined by the following equation:

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

The voltage to change V_2 is provided as the following equation:

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

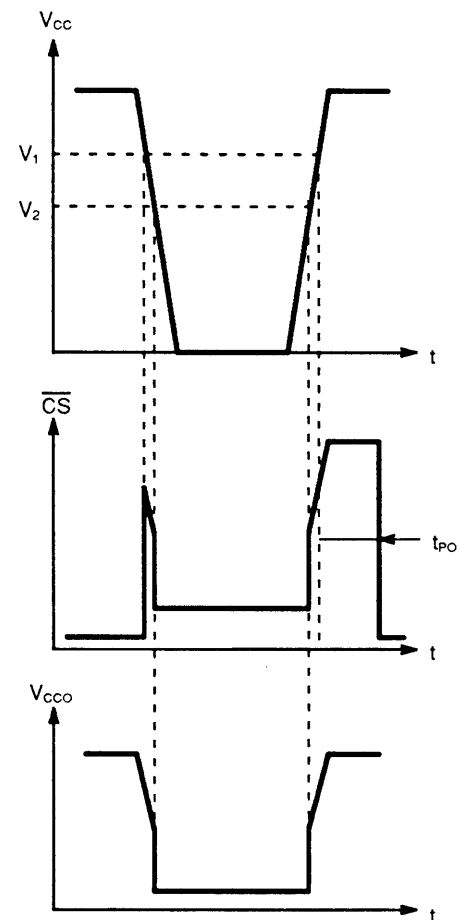


Fig. 1 – Supply Current I_{CC1} vs. Supply Voltage

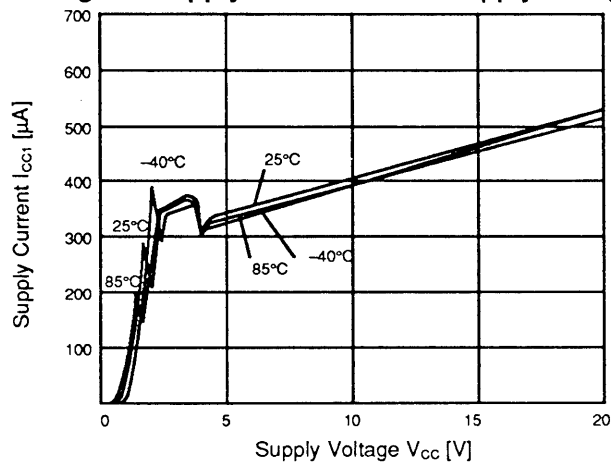


Fig. 2 – Supply Current I_{CC2} vs. Supply Voltage

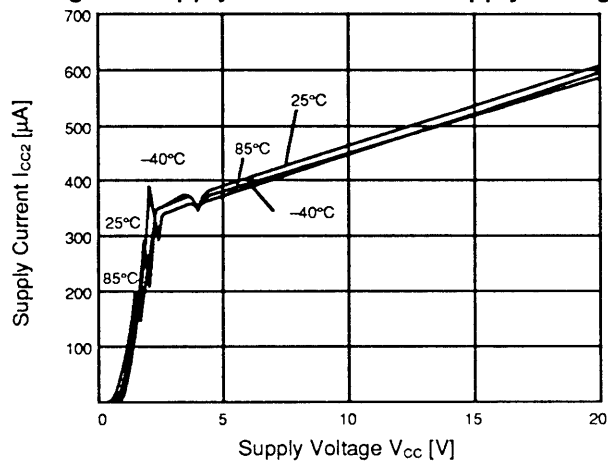


Fig. 3 – Detection Voltage V_{SA} vs. Ambient Temperature

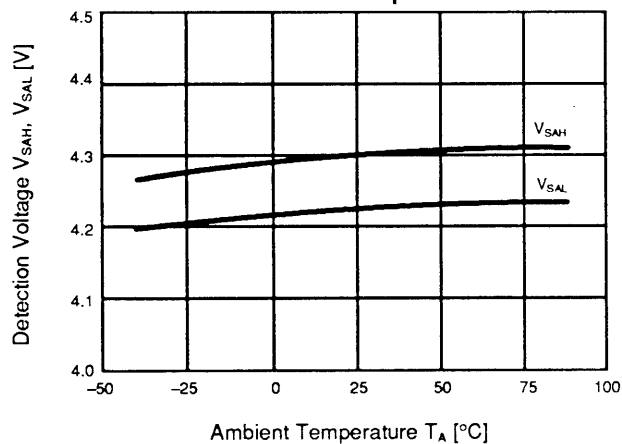


Fig. 4 – Detection Voltage V_{SB} vs. Ambient Temperature

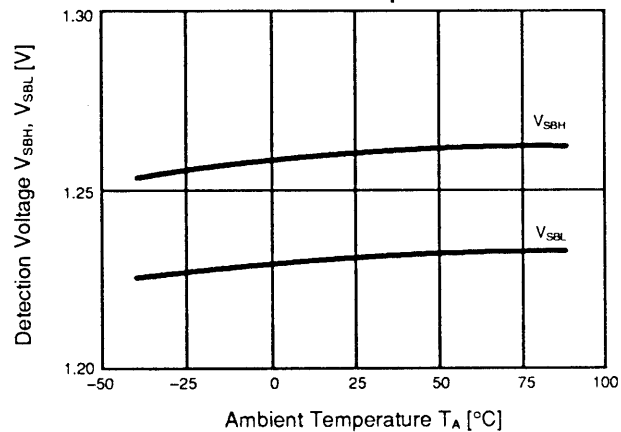


Fig. 5 – Detection Voltage V_{SC} vs. Ambient Temperature

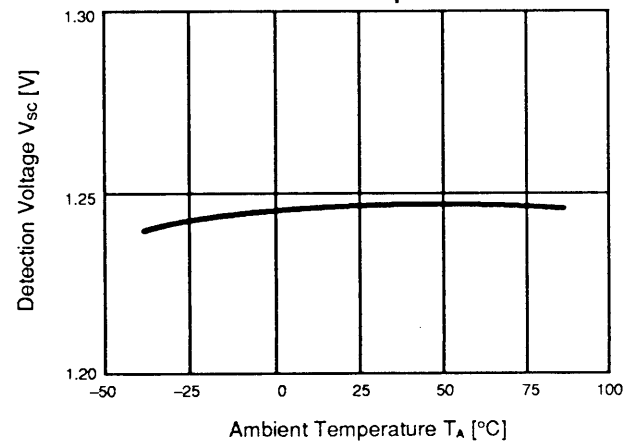


Fig. 6 – Detection Voltage V_{SB} , V_{SC} vs. Supply Voltage

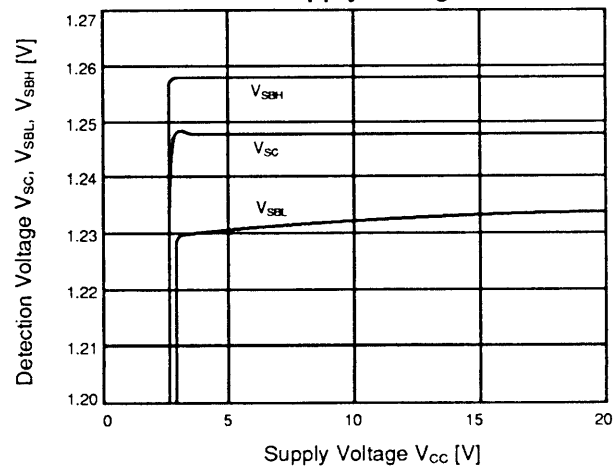


Fig. 7 – $\overline{\text{RESET}}$ Output Voltage vs. Supply Voltage

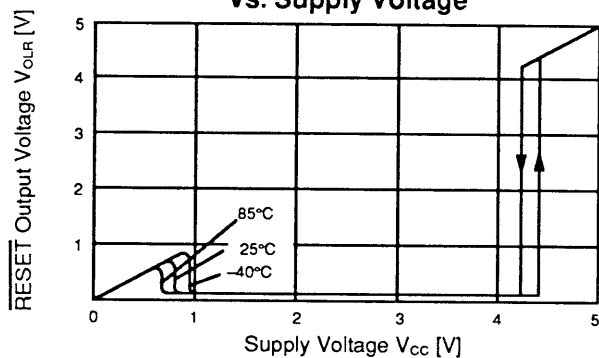


Fig. 8 – $\overline{\text{RESET}}$ High-level Voltage vs. $\overline{\text{RESET}}$ Output Current

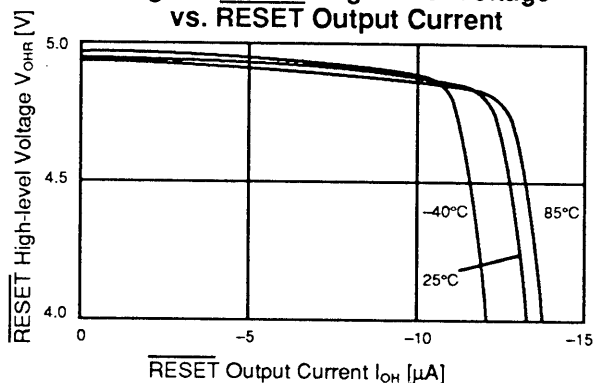


Fig. 9 – $\overline{\text{RESET}}$ Low-level Voltage vs. $\overline{\text{RESET}}$ Output Current

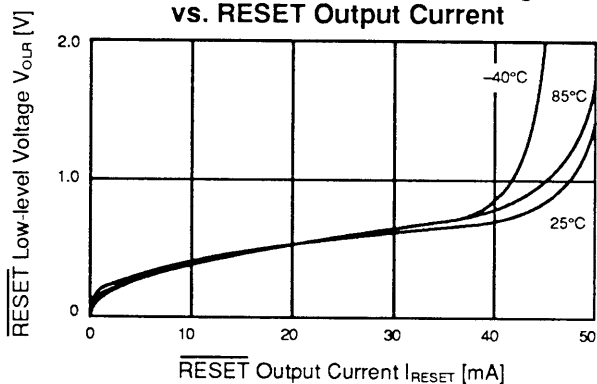


Fig. 10 – OUT_C Output Voltage vs. OUT_C Output Current

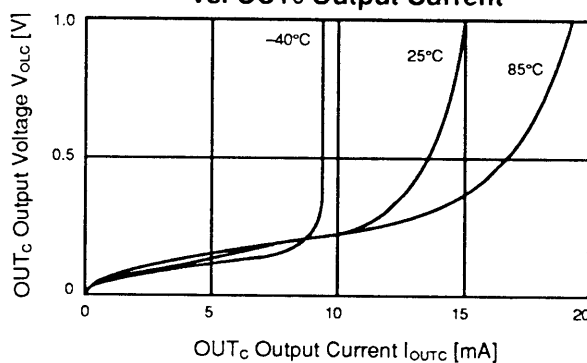


Fig. 11 – C_T Capacitance vs. Reset Hold Time

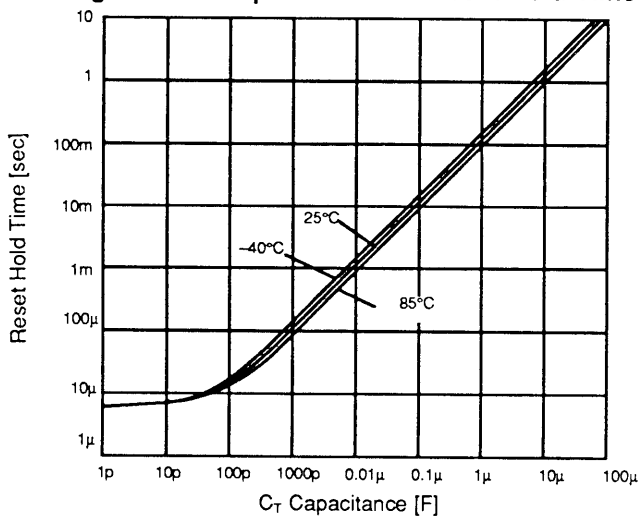
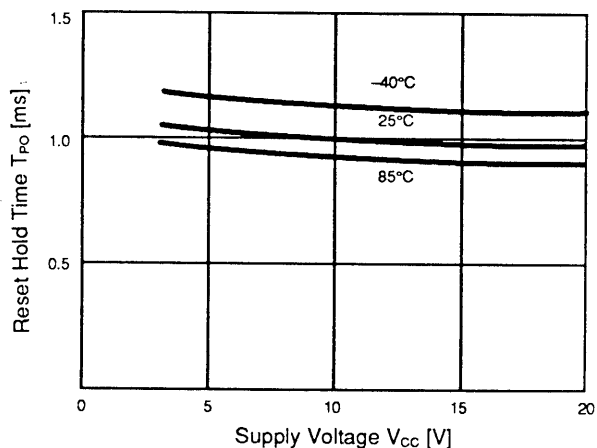
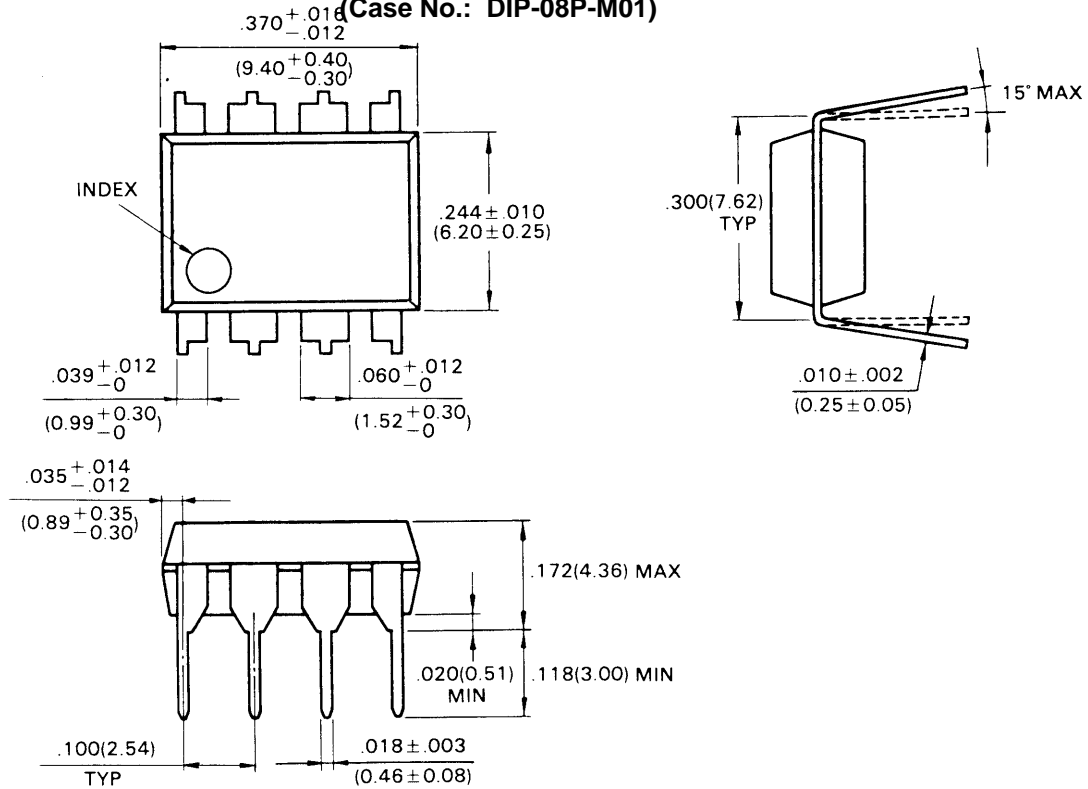


Fig. 12 – Reset Hold Time vs. Supply Voltage ($C_T = 0.01\mu\text{F}$)



PACKAGE DIMENSIONS

8-Lead Plastic Dual In-Line Package
(Case No.: DIP-08P-M01)

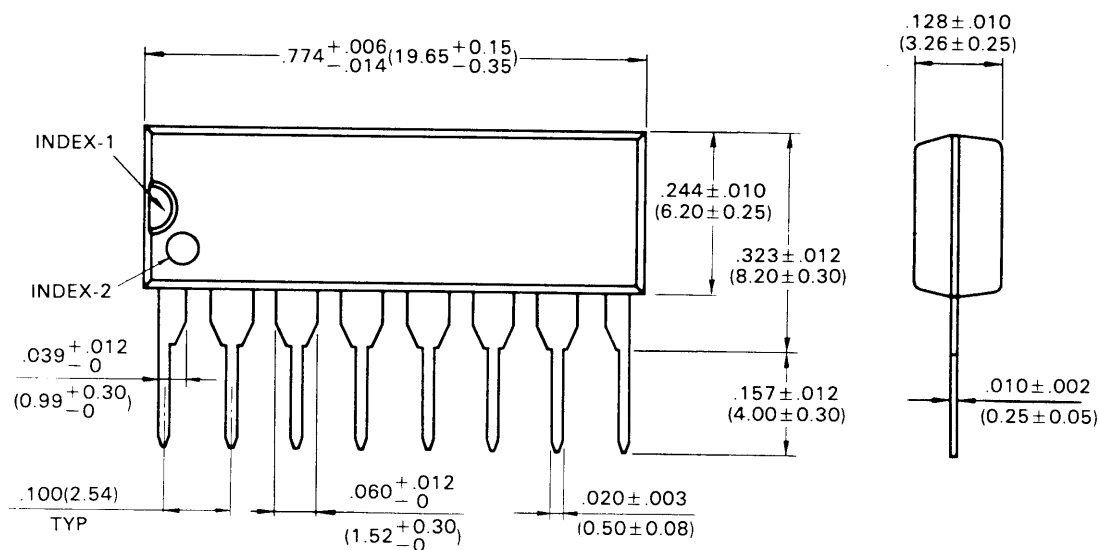


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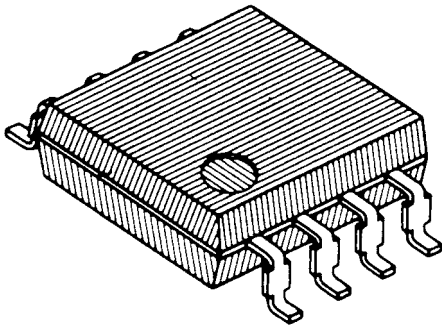
Dimensions in
inches (millimeters)

PACKAGE DIMENSIONS (continued)

8-Lead Plastic Single In-Line Package (Case No.: SIP-08P-M03)

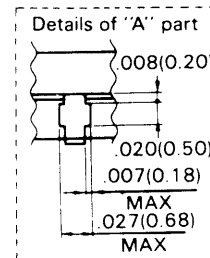
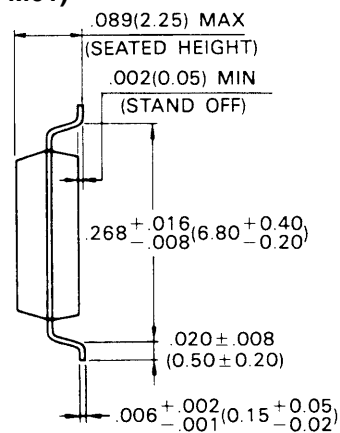
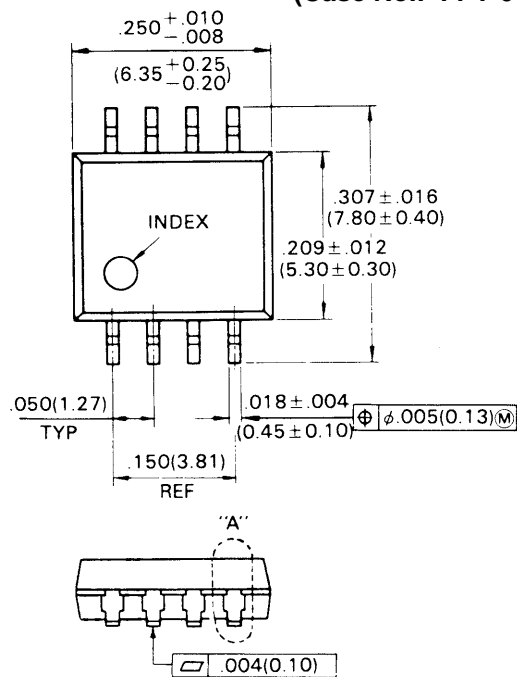


PACKAGE DIMENSIONS (continued)



FPT-08P-M01

8-Lead Plastic Flat Package (Case No.: FPT-08P-M01)



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