FUJITSU

POWER SUPPLY MONITOR

MB 3771

September 1986
Edition 1.0

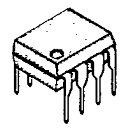
POWER SUPPLY MONITOR

The Fujitsu MB 3771 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.

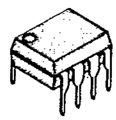
If the circuit's power supply deviates more than a specified amount, then the MB 3771 generates a reset signal to the microprocessor. Thus, the computer data is protected from accidental erasure.

Using the MB 3771 requires few external components. To monitor only a +5V supply, the MB 3771 requires the connection of one external capacitor. The level of an arbitrary dectection voltage is determined by two external resistors.

The MB 3771 is available in an 8-pin Dual In-Line, Signal In-Line Package or space saving Flat Package.



PLASTIC PACKAGE
DIP-08P-M01



PLASTIC PACKAGE
DIP-08P-M02

FPT-08P-M01: See page 20

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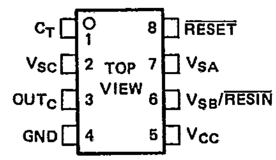
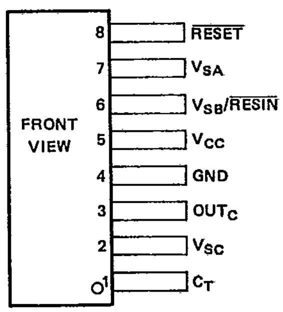
- Precision voltage detection (V_{SA} = 4.1 to 4.3 V)
- User selectable threshold level with hysterisis ($V_{SB} \geqq 1.24$ V)
- Monitors the voltage of one or two power supplies (5 V and an arbitrary voltage, $\geqq 1.23$ V)
- Low voltage output for reset signal (V_{CC} = 0.8 V typ.)
- Minimal number of external components (one capacitor min.)
- Low power dissipation (I_{CC} = 0.35 mA typ., V_{CC} = 5 V)
- Available in a variety of packages
  - 8-pin Dual In-Line Package
  - 8-pin Single In-Line Package
  - 8-pin Flat Package

PIN ASSIGNMENT





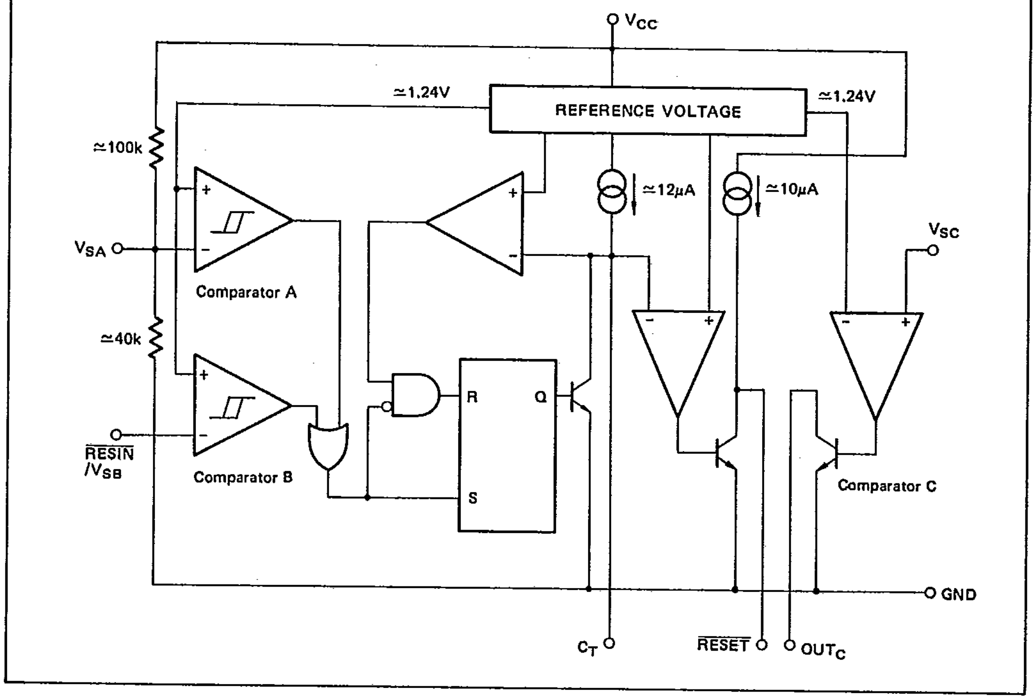
ABSOLUTE MAXIMUM RATINGS

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 ($T_A \leqq 85°C$)	mW
Storage Temperature	T_{STG}	-55 to +125	°C

NOTE: Permanent device damage may occur if 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.

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.

BLOCK DIAGRAM OF MB 3771



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 hysterisis. 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 MB 3771 can detect about 2μs voltage sag/surge of the power supply. The user can add delayed trigger capacity by connecting a capacitor between inputs V_{SA} and V_{SB}. (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 ($\overline{RESET}$)	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

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ELECTORICAL 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
	V_{CC}, 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
	V_{CC}, T_A = -40 to +85°C		4.15	4.30	4.45	V
Hysterisis 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
Hysterisis 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_{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

ELECTORICAL CHARACTERISTICS (Cont'd)

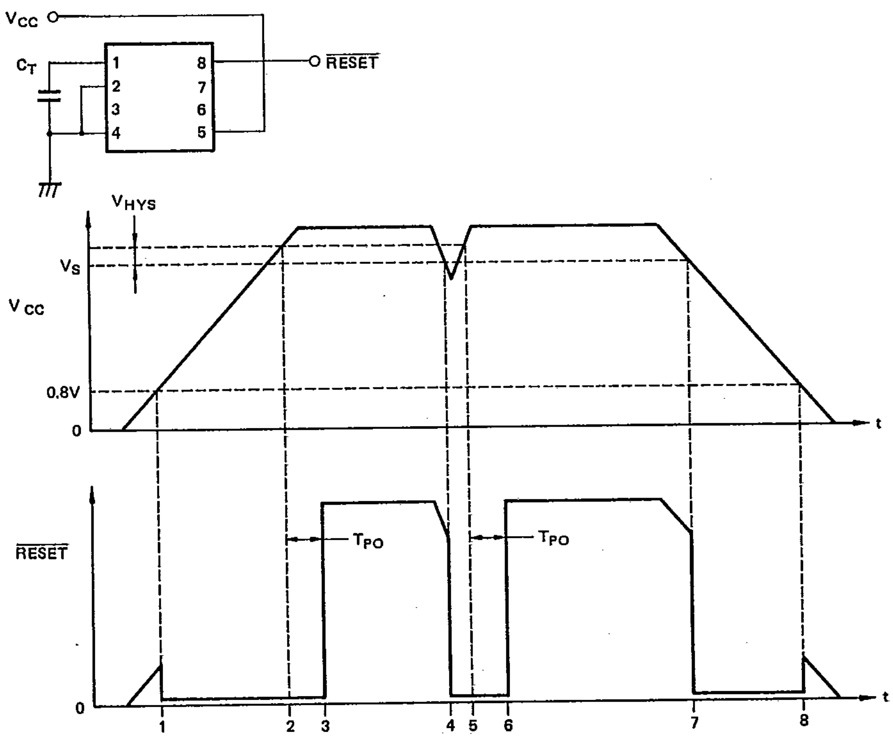
DC Characteristics (V_{CC} = 5V, T_A = 25°C)

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}	V_{SC}	1.225	1.245	1.265	V
	V_{SC}, 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	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 = 2.2kΩ, 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	V_{SB}	t_{PD}		2	10	μs
	V_{SC}, R_L = 2.2kΩ, C_L = 100pF	t_{PHL}		0.5		μs
	V_{SC}, R_L = 2.2kΩ, C_L = 100pF	t_{PLH}		1.0		μs

FUNCTION EXPLANATION



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.

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

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

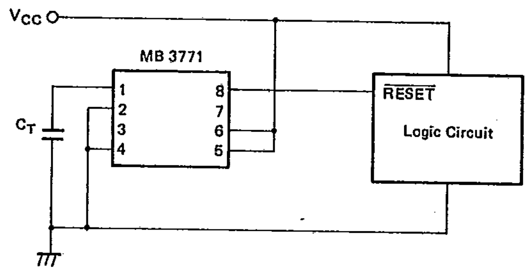
Point 5: When V_{CC} level reaches $V_S + V_{HYS}$, then C_T starts charging.
In the case of voltage sagging, if the period from the time V_{CC} goes lower than or equal to V_S to the time V_{CC} reaches $V_S + V_{HYS}$ again, is longer than t_{P1}, (as speicified in the AC Characteristics), C_T is discharged 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.

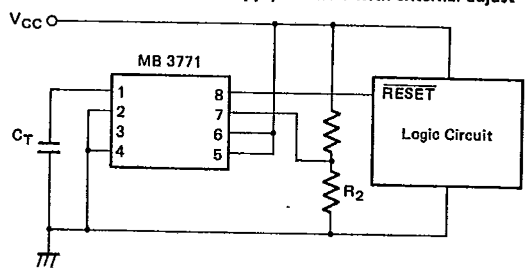
Point 8: $\overline{\text{RESET}}$ remains low until V_{CC} drops below 0.8V.

EXAMPLE 1: 5V Power Supply Monitor



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

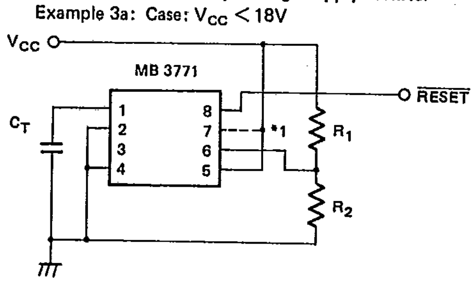
EXAMPLE 2: 5V Power Supply Monitor with external adjust



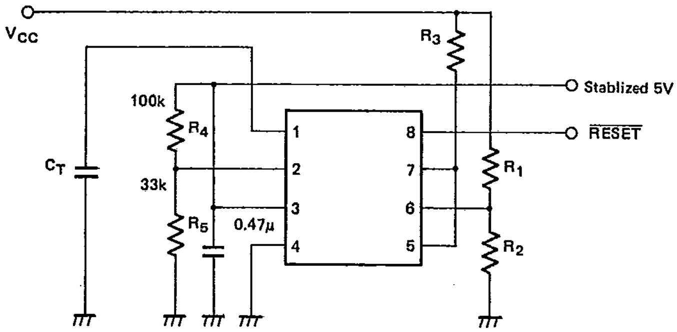
NOTE: Detection voltages can be adjusted as shown below.

R_1 [kΩ]	R_2 [kΩ]	Detection Voltage V_{SAL} [V]	Detection Voltage V_{SAH} [V]
10	3.9	4.4	4.5
9.1	3.9	4.1	4.2

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



EXAMPLE 3: Arbitrary Voltage Supply Monitor
Example 3b: Case: $V_{CC} \geq 18V$

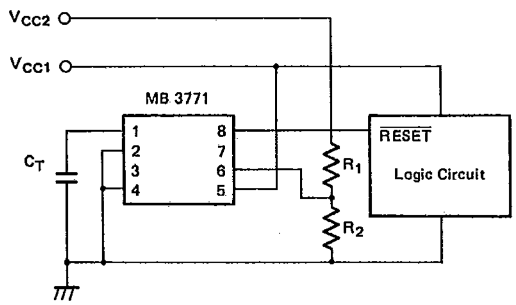


- $\overline{RESET}$ output levels range from 0V to 1V approximately. Device damage may occur if $\overline{RESET}$ exceeds its high level (1V).
- Output voltage and maximum $\overline{RESET}$ voltage levels are determined by resistor R_1 and R_2.
- In this case, the 5V stabilized output can be used 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 adequat RESET [V]	R_1 [MΩ]	R_2 [kΩ]	R_3 [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} = 100μA, V_{OLC} = 0.4V. All resistor are 1/4W.

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

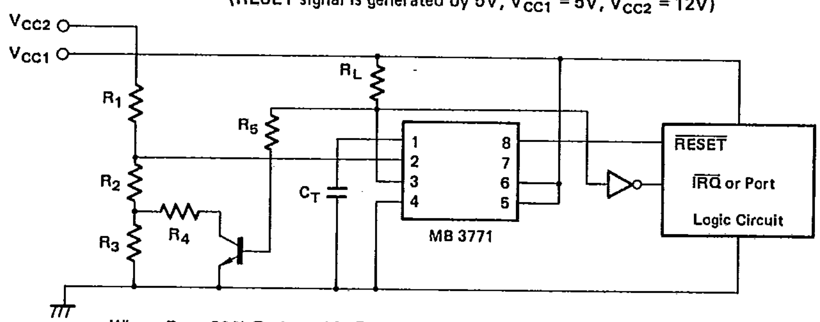


NOTE: 5V is monitored by V_{SA}. Detection voltage is about 4.2V.

12V is monitored by V_{SB}. When R_1 = 390kΩ and R_2 = 62kΩ, Detection voltage is about 9.0V. Generally the detection voltage is determined by the following equation.

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

EXAMPLE 5: 5V and 12V Power Supply Monitor
($\overline{RESET}$ signal is generated by 5V, V_{CC1} = 5V, V_{CC2} = 12V)



Where R_1 = 390kΩ, R_2 = 33kΩ, R_3 = 30kΩ, R_4 = 100kΩ, R_L = 10kΩ

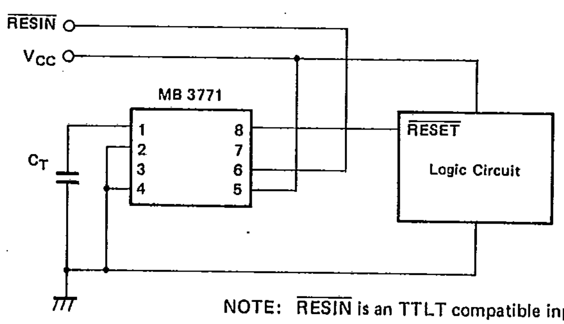
NOTE: 5V is monitored by V_{SA}, and generates $\overline{RESET}$ signal when V_{SA} detects voltage sagging. 12V is monitored by V_{SC}, and generates its detection signal at OUT_C.

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

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

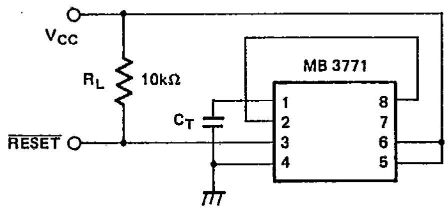
$$\text{Hysterisis width} = \frac{R_1 (R_3 - R_3 \| R_4)}{(R_2 + R_3)(R_2 + R_3 \| R_4)} V_{SC} \text{ (200mA in the circuit above)}$$

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



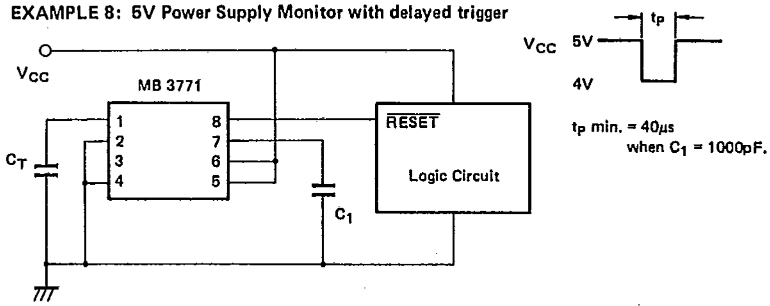
NOTE: $\overline{RESIN}$ is an TTLT compatible input.

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

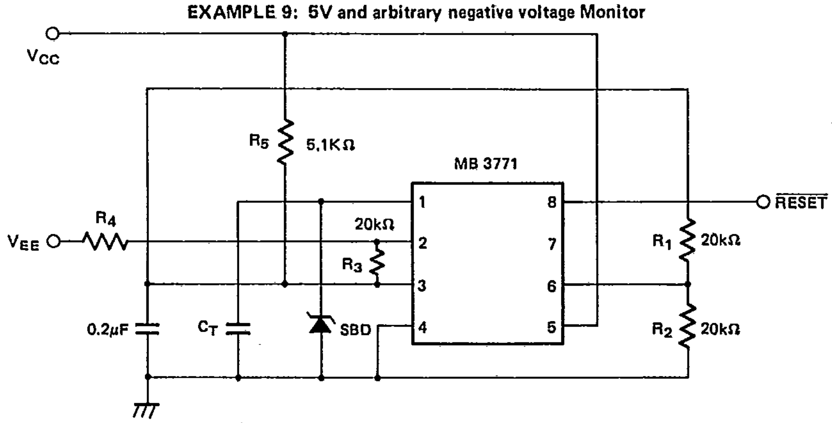


NOTE: In this case, Comparator C is used to invert $\overline{RESET}$ signal. OUT_C is an open-collector output. R_L is used as a pull-up resistor.

EXAMPLE 8: 5V Power Supply Monitor with delayed trigger



EXAMPLE 9: 5V and arbitrary negative voltage Monitor

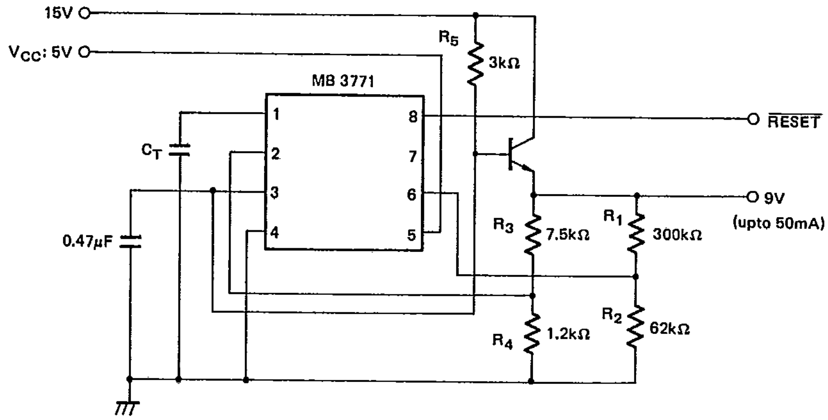


NOTE: +5V and negative voltage are monitored at V_{CC} and V_{EE} respectively. R_1, R_2, and R_3 should be the same value. The negative detection voltage is determined by as the following equation.

Detection voltage $V_S = V_{SB} - V_{SB} \cdot R_4/R_3$

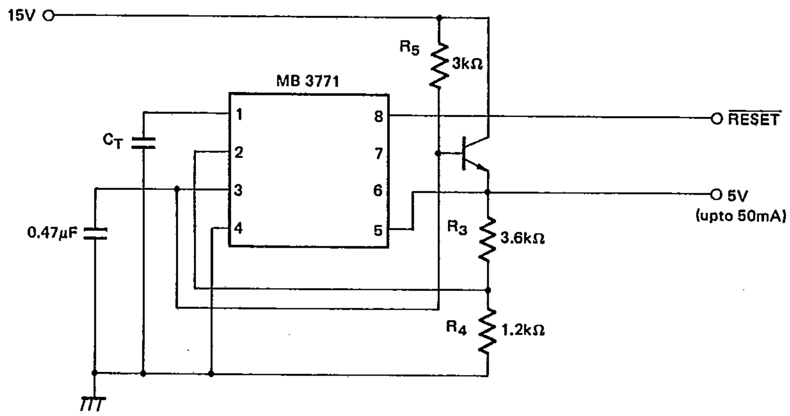
Example: When V_{EE} = -5V and R_4 = 91kΩ, V_S = -4.37V.

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



NOTE: Detection Voltage: $V_S = 7.2V$

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



NOTE: Detection Voltage: $V_S = 4.2V$

NOTE: 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: $V_S = (R_1 + R_2) \cdot V_{SB}/R_2$

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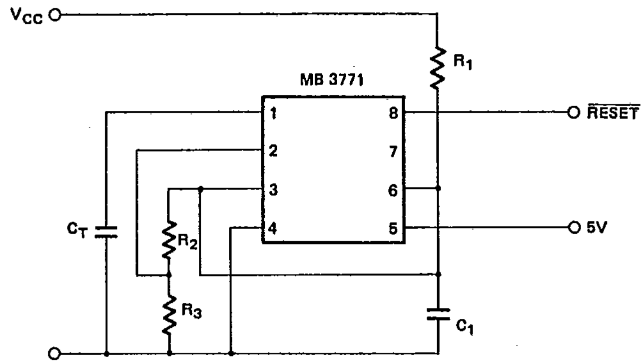
Example 10c: 5V Reference Voltage Generation and 5V Monitoring

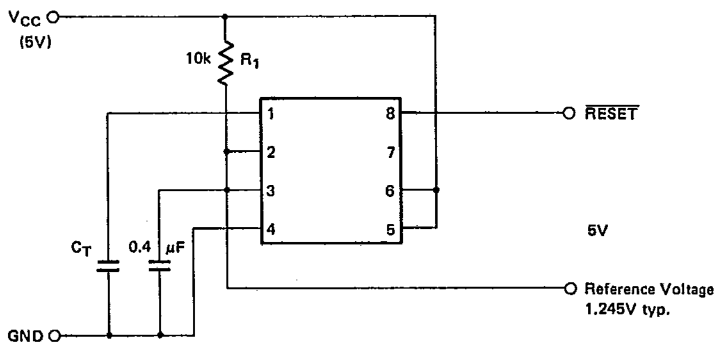


Using the reference table below, the value of R_1 can be determined. Where R_2 is 100kΩ, R_3 is 33kΩ, C_1 is 0.47μF.

Reference Table of R_1, V_{CC}, and the output current

V_{CC} [V]	R_1 [kΩ]	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 1.2kΩ as R_1, reference current is about 2mA.

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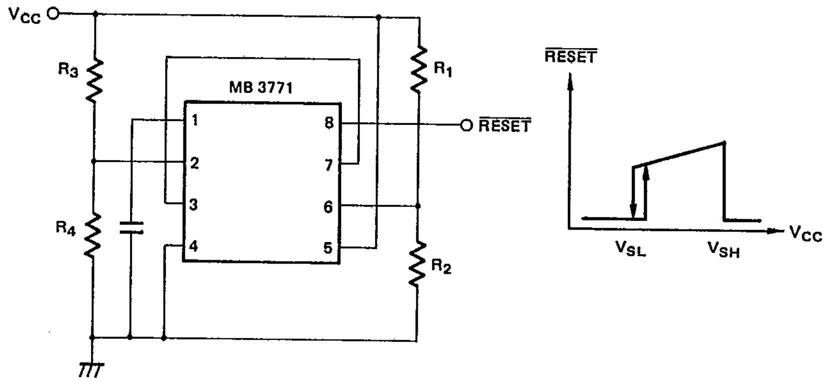
EXAMPLE 11: Low Voltage and Over Voltage Detection



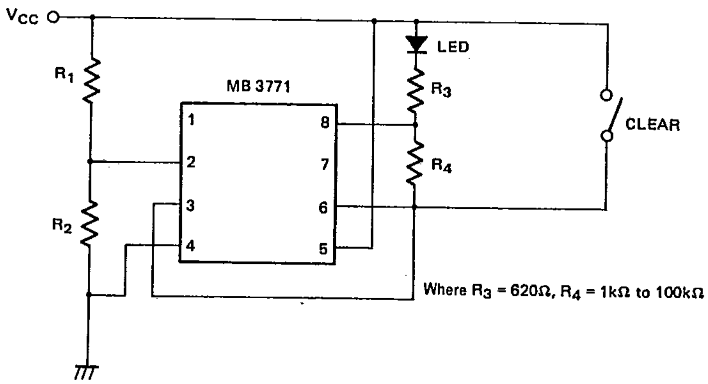
NOTE: V_{SH} has no hysteresis. When over voltage is detected, $\overline{RESET}$ is held in the constant time as well as when low voltage is detected.

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

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

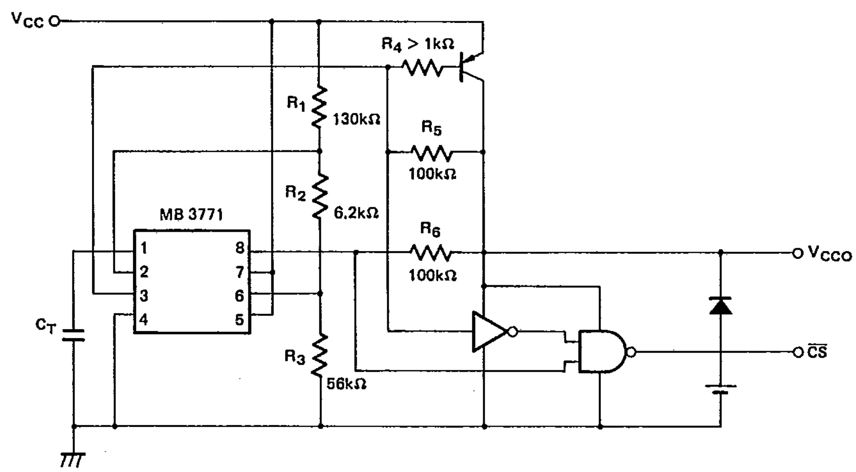
EXAMPLE 12: Detection of Abnormal State of Power Supply System

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 R_1 and R_2 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 $V_2 < V_1$.

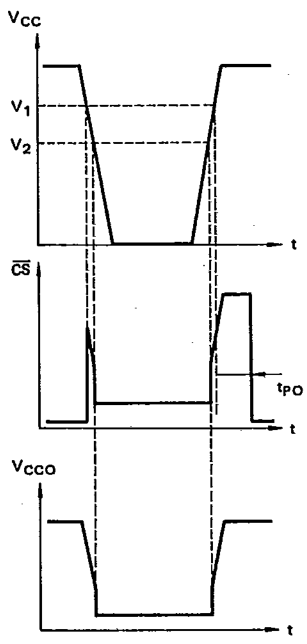
During t_{PO}, memory access is prohibited.

CS's threshold voltage V_1 is determined by the following equation:

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

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

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



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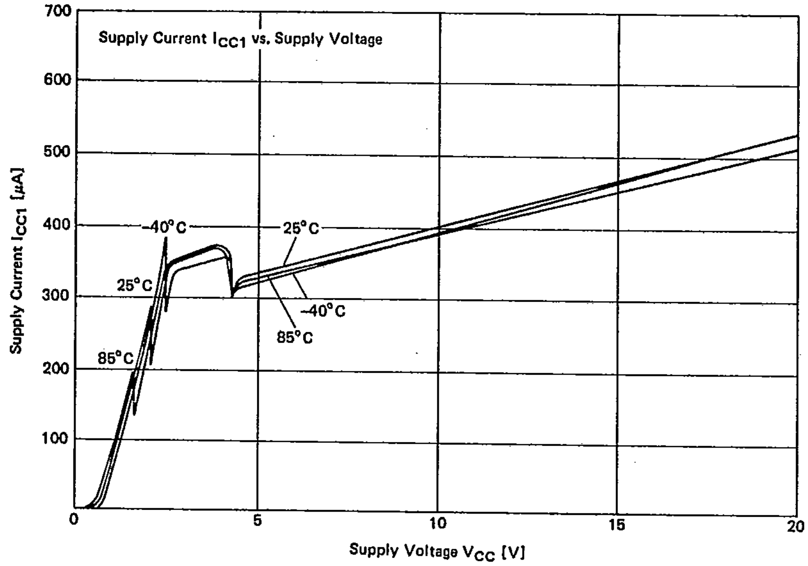
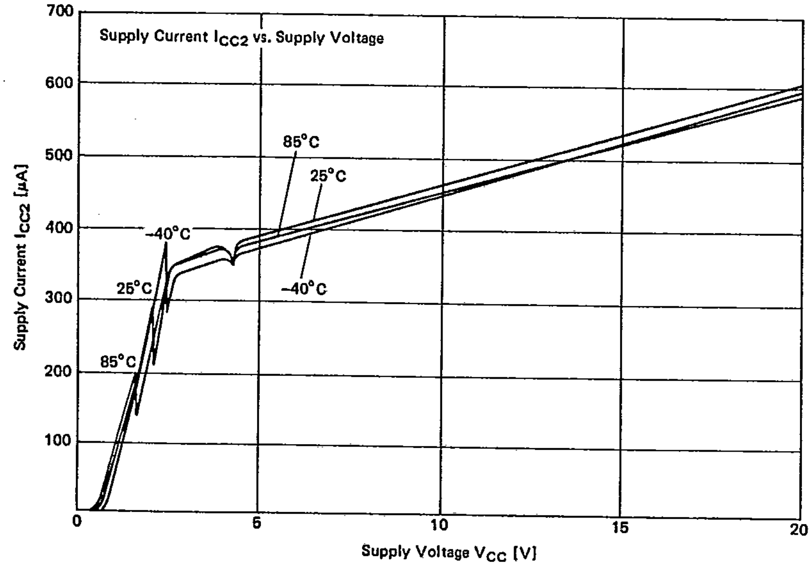
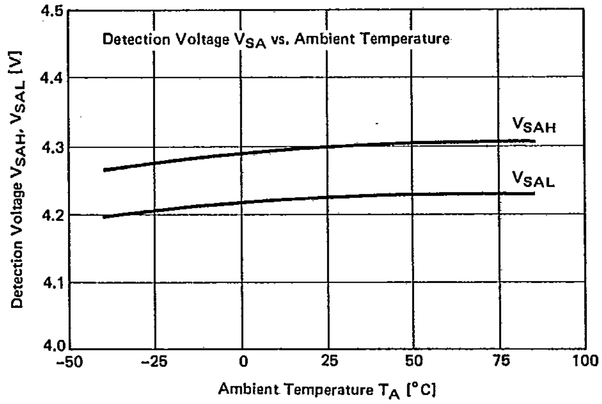
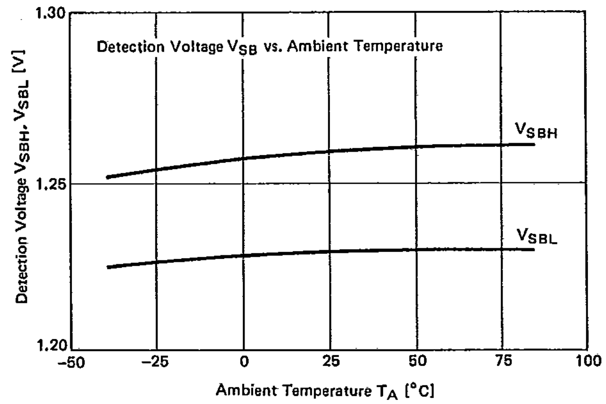
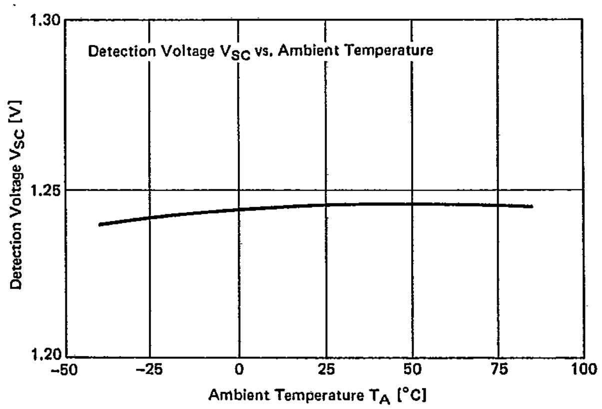

Supply Current ICC1 vs. Supply Voltage
Supply Current ICC1 [μA]
Supply Voltage VCC [V]
-40°C
25°C
85°C
25°C
-40°C
85°C
700
600
500
400
300
200
100
0
5
10
15
20

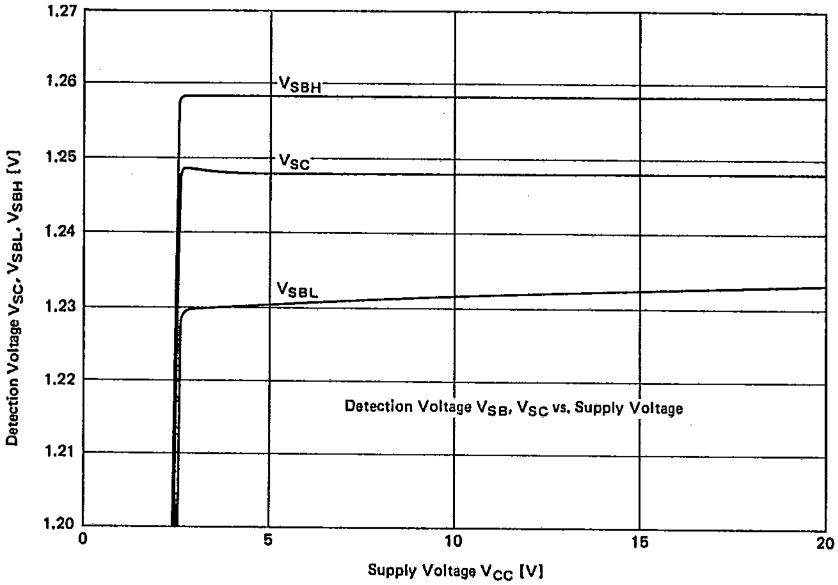

Supply Current ICC2 vs. Supply Voltage
Supply Current ICC2 [μA]
Supply Voltage VCC [V]
-40°C
25°C
85°C
85°C
25°C
-40°C
700
600
500
400
300
200
100
0
5
10
15
20

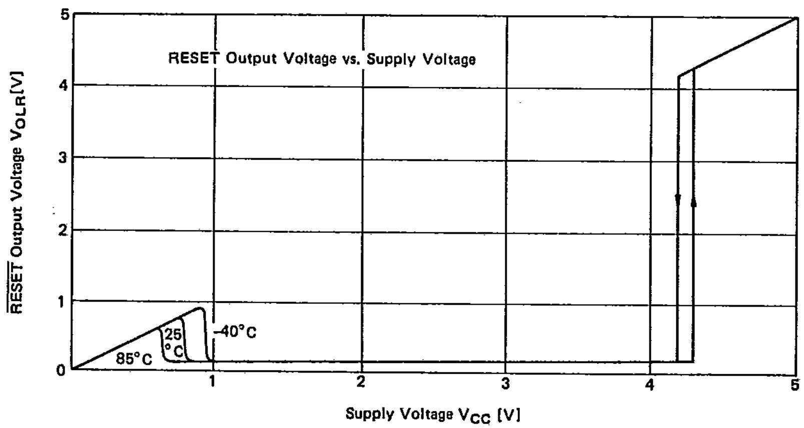

Detection Voltage VSA vs. Ambient Temperature
VSAH
VSAL
Detection Voltage VSAH, VSAL [V]
4.5
4.4
4.3
4.2
4.1
4.0
-50
-25
0
25
50
75
100
Ambient Temperature TA [°C]

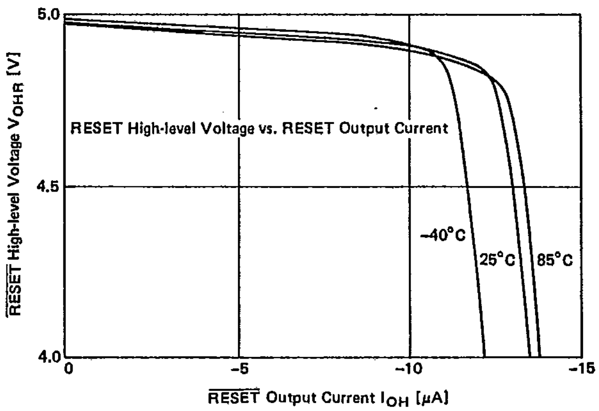

Detection Voltage VSB vs. Ambient Temperature
VSBH
VSBL
Detection Voltage VSBH, VSBL [V]
1.30
1.25
1.20
-50
-25
0
25
50
75
100
Ambient Temperature TA [°C]

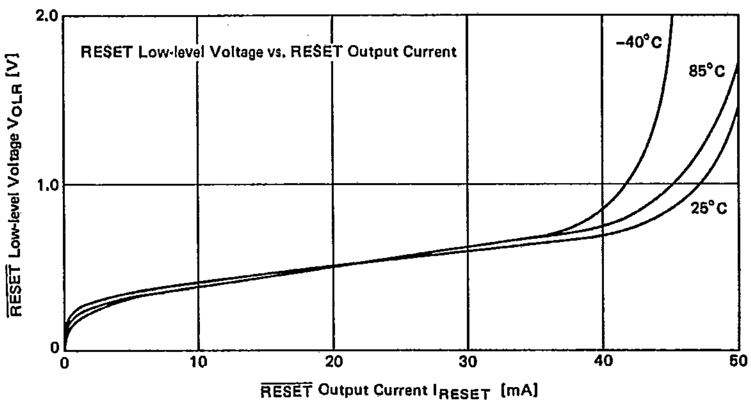

Detection Voltage VSC vs. Ambient Temperature
Detection Voltage VSC [V]
1.30
1.25
1.20
-50
-25
0
25
50
75
100
Ambient Temperature TA [°C]

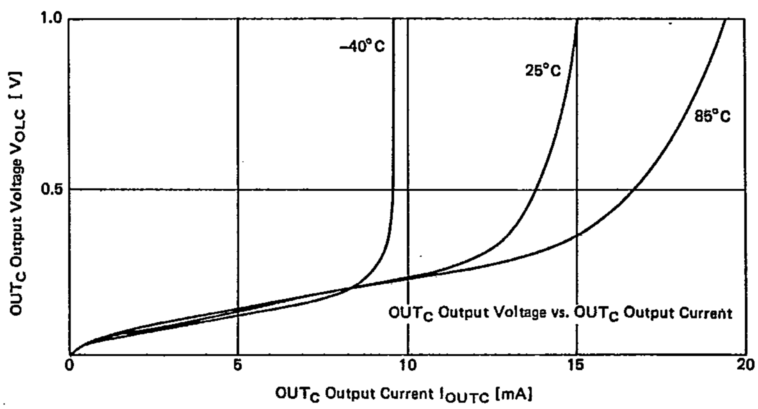
4

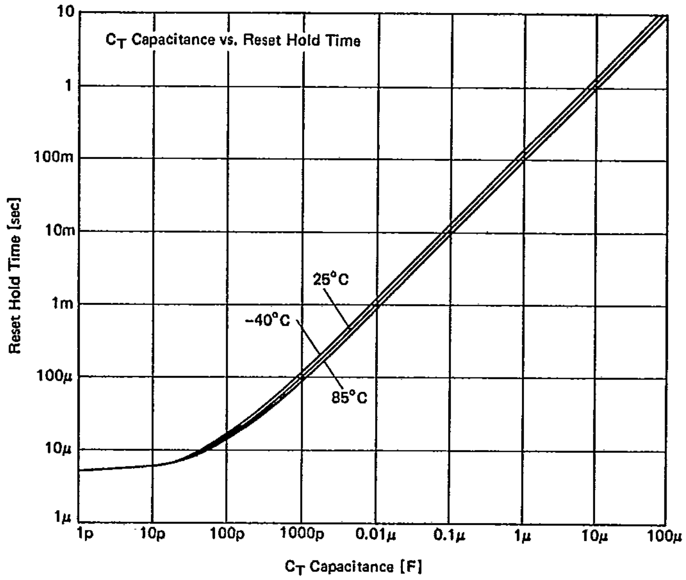

1.27
1.26
1.25
1.24
1.23
1.22
1.21
1.20
Detection Voltage V_{SC}, V_{SBL}, V_{SBH} [V]
V_{SBH}
V_{SC}
V_{SBL}
Detection Voltage V_{SB}, V_{SC} vs. Supply Voltage
0
5
10
15
20
Supply Voltage V_{CC} [V]

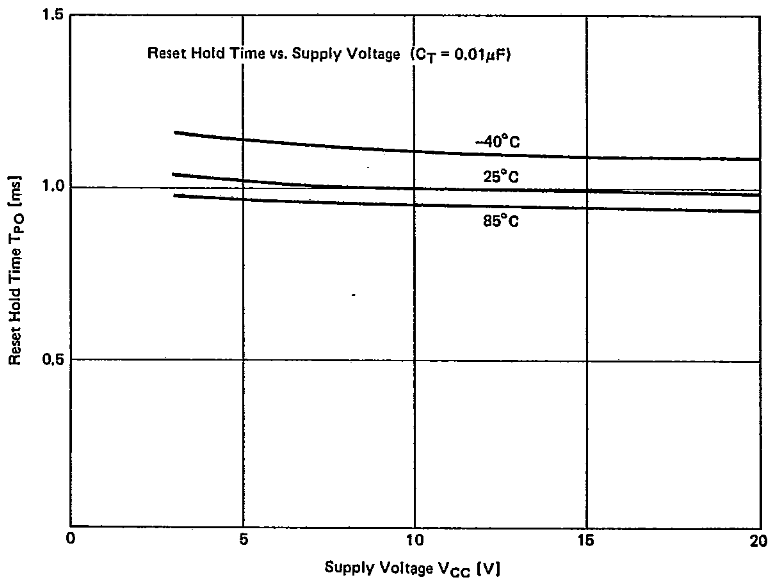

5
4
3
2
1
0
$\overline{RESET}$ Output Voltage V_{OLR}[V]
RESET Output Voltage vs. Supply Voltage
85°C
25 °C
-40°C
1
2
3
4
5
Supply Voltage V_{CC} [V]


RESET High-level Voltage vs. RESET Output Current
RESET High-level Voltage V_{OHR} [V]
5.0
4.5
4.0
0
-5
-10
-15
-40°C
25°C
85°C
RESET Output Current I_{OH} [μA]


RESET Low-level Voltage vs. RESET Output Current
RESET Low-level Voltage V_{OLR} [V]
2.0
1.0
0
10
20
30
40
50
-40°C
85°C
25°C
RESET Output Current I_{RESET} [mA]


OUT_C Output Voltage vs. OUT_C Output Current
OUT_C Output Voltage V_{OLC} [V]
1.0
0.5
0
5
10
15
20
-40°C
25°C
85°C
OUT_C Output Current I_{OUTC} [mA]

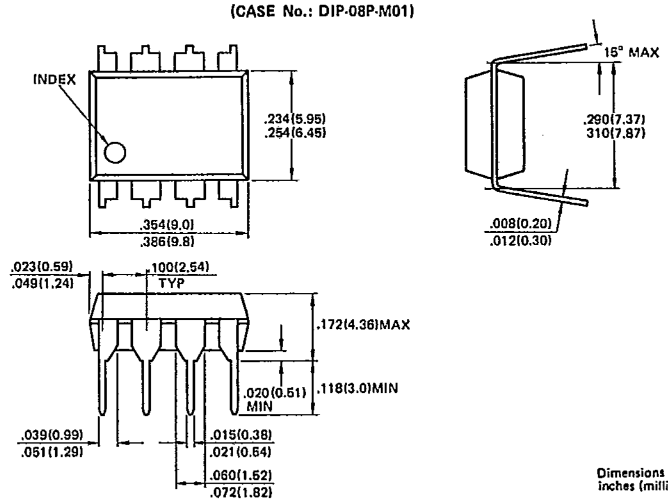

C_T Capacitance vs. Reset Hold Time
10
1
100m
10m
1m
100μ
10μ
1μ
Reset Hold Time [sec]
25°C
−40°C
85°C
1p
10p
100p
1000p
0.01μ
0.1μ
1μ
10μ
100μ
C_T Capacitance [F]


Reset Hold Time vs. Supply Voltage (C_T = 0.01μF)
1.5
1.0
0.5
Reset Hold Time T_{PO} [ms]
−40°C
25°C
85°C
0
5
10
15
20
Supply Voltage V_{CC} [V]

T-73-53

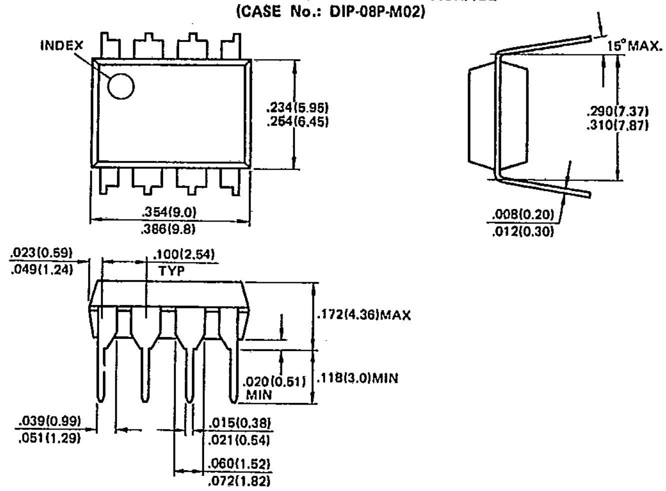
PACKAGE DIMENSIONS

8-LEAD PLASTIC DUAL-IN-LINE PACKAGE
(CASE No.: DIP-08P-M01)



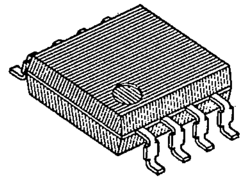
Dimensions in inches (millimeters)

8-LEAD PLASTIC DUAL-IN-LINE PACKAGE
(CASE No.: DIP-08P-M02)

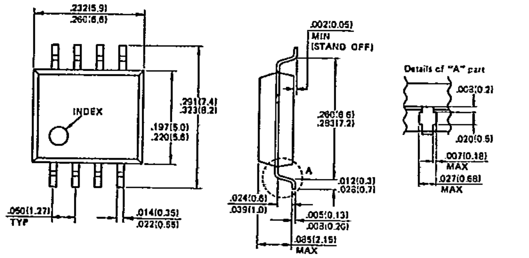


Dimensions in inches (millimeters)

PACKAGE DIMENSIONS



8-LEAD PLASTIC FLAT PACKAGE
(CASE No. : FPT-08P-M01)



Dimensions in inches
(millimeters)