

# MB3761

## VOLTAGE DETECTOR

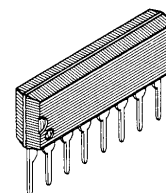
### VOLTAGE DETECTOR

#### DESCRIPTION

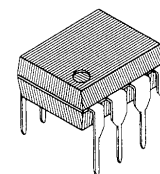
Designed for voltage detector applications, the Fujitsu MB3761 is a dual comparator with a built-in high precision reference voltage generator. Outputs are open-collector outputs and enable use of the OR-connection between both channels. Both channels have hysteresis control outputs. Because of a wide power supply voltage range and a lowpower supply current, the MB3761 is suitable for power supply monitors and battery backup systems.

#### FEATURES

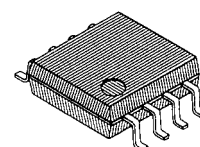
- Wide power supply voltage range: 2.5V to 40V
- Low power and small voltage dependency supply current: 250A typical.
- Built-in stable low voltage generator: 1.20V typical.
- Easy-to-add hysteresis characteristics.
- Package: 8-pin Plastic SIP Package (Suffix: —PS)  
— 8-pin Plastic DIP Package (Suffix: —P)  
— 8-pin Plastic FPT Package (Suffix: —PF)



Plastic Package  
SIP-08P-M03



Plastic Package  
DIP-08P-M01



Plastic Package  
FPT-08P-M01

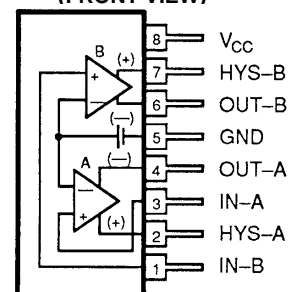
#### ABSOLUTE MAXIMUM RATINGS (See NOTE)

Rating	Symbol	Value	Unit
Power Supply Voltage	$V_{CC}$	41	V
Output Voltage	$V_O$	41	V
Output Current	$I_O$	50	mA
Input Voltage	$V_{IN}$	-0.3 to +6.5	V
Power Dissipation	$P_D$	350 ( $T_A \leq 70^\circ\text{C}$ )	mW
Storage Temperature	$T_{STG}$	-55 to 125	$^\circ\text{C}$

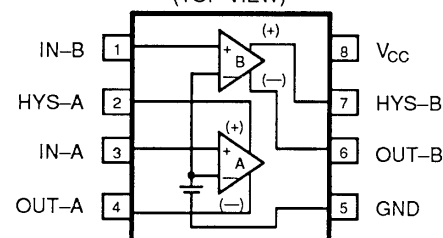
NOTE: Permanent device damage may occur if Absolute Maximum Ratings are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

#### Pin Assignment

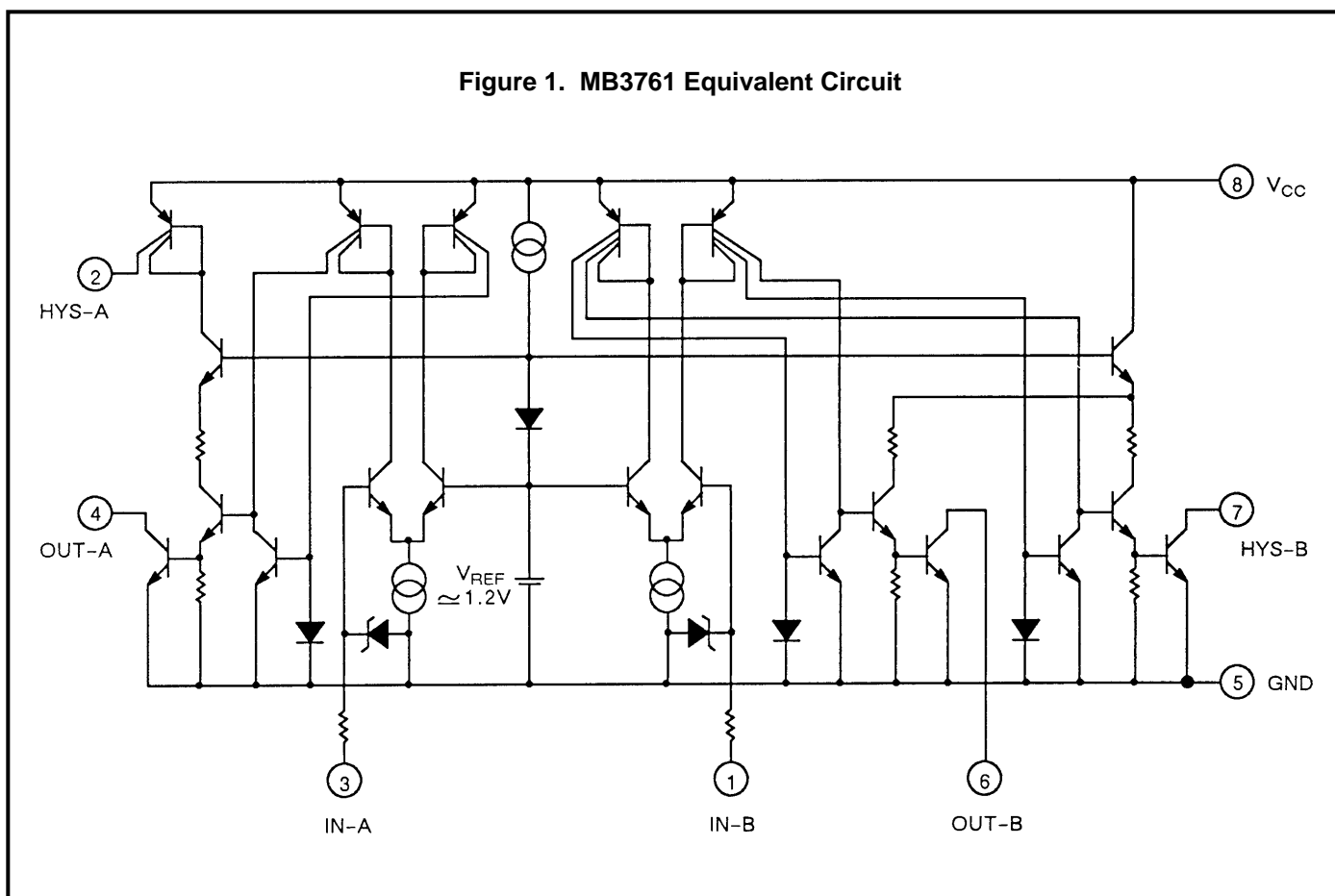
##### (FRONT VIEW)



##### (TOP VIEW)



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.

**Figure 1. MB3761 Equivalent Circuit**


## RECOMMENDED OPERATING CONDITIONS

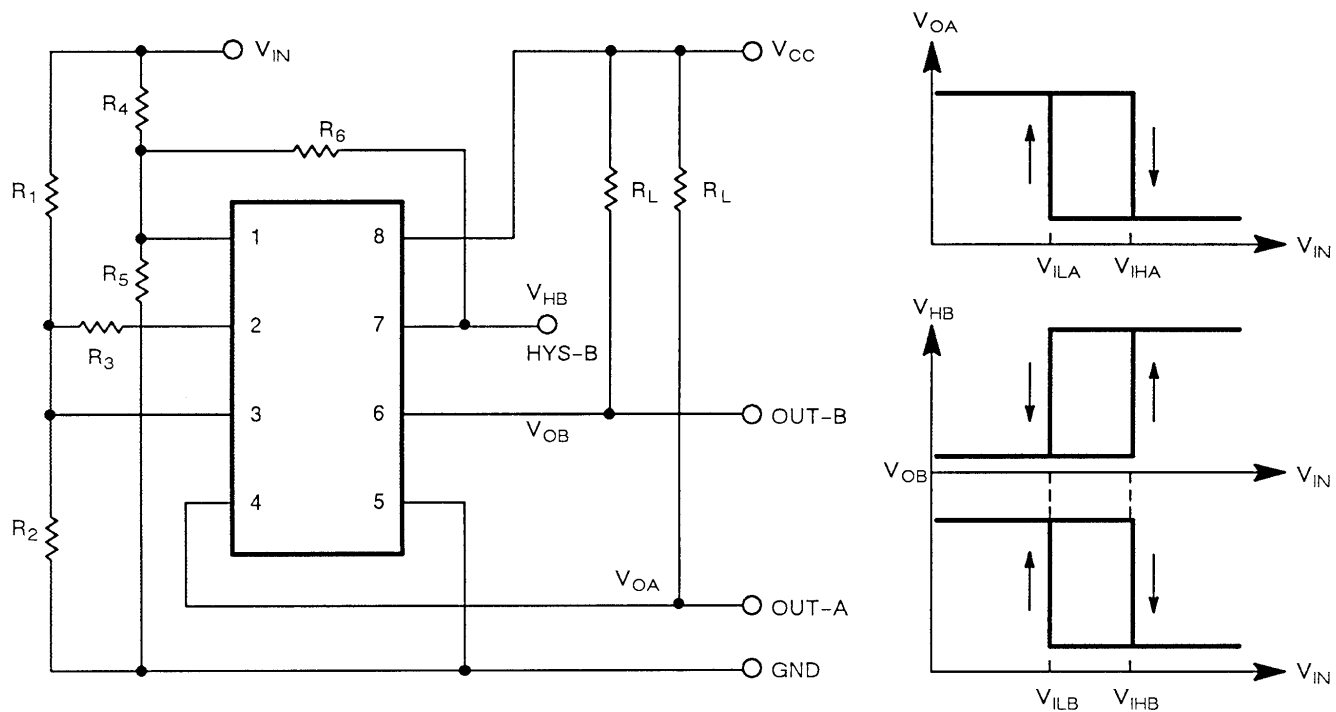
Parameter	Symbol	Value	Unit
Power Supply Voltage	$V_{CC}$	2.5 to 40	V
Operating Temperature	$T_A$	-20 to 75	°C
Output Current at pin 4	$I_{O4}$	4.5	mA
Output Current at pin 6	$I_{O6}$	3.0	mA

# ELECTRICAL CHARACTERISTICS

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

Parameter	Designator	Conditions	Values			Unit
			Min	Typ	Max	
Power Supply Voltage	$I_{CCL}$	$V_{CC} = 40\text{V}$ , $V_{IL} = 1.0\text{V}$		250	400	$\mu\text{A}$
	$I_{CCH}$	$V_{CC} = 40\text{V}$ , $V_{IH} = 1.5\text{V}$		400	600	$\mu\text{A}$
Threshold Voltage	$V_{TH}$	$I_O = 2\text{mA}$ , $V_O = 1\text{V}$	1.15	1.20	1.25	V
Deviation of Threshold Voltage	$\Delta V_{TH1}$	$2.5\text{V} \leq V_{CC} \leq 5.5\text{V}$		3	12	mV
	$\Delta V_{TH2}$	$4.5\text{V} \leq V_{CC} \leq 40\text{V}$		10	40	mV
Offset Voltage between Outputs	$V_{OOSA}$	$I_{OA} = 4.5\text{mA}$ , $V_{OA} = 2\text{V}$ $I_{HA} = 20\mu\text{A}$ , $V_{HA} = 3\text{V}$		2.0		mV
	$V_{OOSB}$	$I_{OB} = 3\text{mA}$ , $V_{OB} = 2\text{V}$ $I_{HB} = 3\text{mA}$ , $V_{HB} = 2\text{V}$		2.0		mV
Temperature Coefficient of Threshold Voltage	a	$-20^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$		0.05		mV/ $^\circ\text{C}$
Difference Voltage on Threshold Voltage between Channel	$\Delta V_{THAB}$		-10		10	mV
Input Current	$I_{IL}$	$V_{IL} = 1.0\text{V}$		5		nA
	$I_{IH}$	$V_{IH} = 1.5\text{V}$		100	500	nA
Output Leakage Current	$I_{OH}$	$V_O = 40\text{V}$ , $V_{IL} = 1.0\text{V}$			1	$\mu\text{A}$
Hysteresis Output Leakage Current	$I_{HLA}$	$V_{CC} = 40\text{V}$ , $V_{HA} = 0\text{V}$ , $V_{IL} = 1.0\text{V}$			0.1	$\mu\text{A}$
	$I_{HHB}$	$V_{HB} = 40\text{V}$ , $V_{IH} = 1.5\text{V}$			1	$\mu\text{A}$
Output Sink Current	$I_{OLA}$	$V_O = 1.0\text{V}$ , $V_{IH} = 1.5\text{V}$	6	12		mA
	$I_{OLB}$	$V_O = 1.0\text{V}$ , $V_{IH} = 1.5\text{V}$	4	10		mA
Hysteresis Current	$I_{HHA}$	$V_H = 0\text{V}$ , $V_{IH} = 1.5\text{V}$	40	80		$\mu\text{A}$
	$I_{HLB}$	$V_H = 0\text{V}$ , $V_{IH} = 1.5\text{V}$	4	10		mA
Output Saturation Voltage	$V_{OLA}$	$I_O = 4.5\text{mA}$ , $V_{IH} = 1.5\text{V}$		120	400	mV
	$V_{OLB}$	$I_O = 3.0\text{mA}$ , $V_{IH} = 1.5\text{V}$		120	400	mV
Hysteresis Saturation Voltage	$V_{HHA}$	$I_H = 20\mu\text{A}$ , $V_{IH} = 1.5\text{V}$		50	200	mV
	$V_{HLB}$	$I_H = 3.0\text{mA}$ , $V_{IL} = 1.0\text{V}$		120	400	mV
Output Delay Time	$t_{PHL}$	$R_L = 5\text{k}\Omega$		2		$\mu\text{s}$
	$t_{PLH}$	$R_L = 5\text{k}\Omega$		3		$\mu\text{s}$

Figure 2. Operational Definitions



$$V_{IHA} = (1 + \frac{R_1}{R_2}) V_R$$

$$V_{ILA} = (1 + \frac{R_1}{R_2 // R_3}) V_R - \frac{R_1}{R_3} V_{CC}$$

$$V_{IHB} = (1 + \frac{R_4}{R_5 // R_6}) V_R$$

$$V_{ILB} = (1 + \frac{R_4}{R_5}) V_R$$

NOTE)

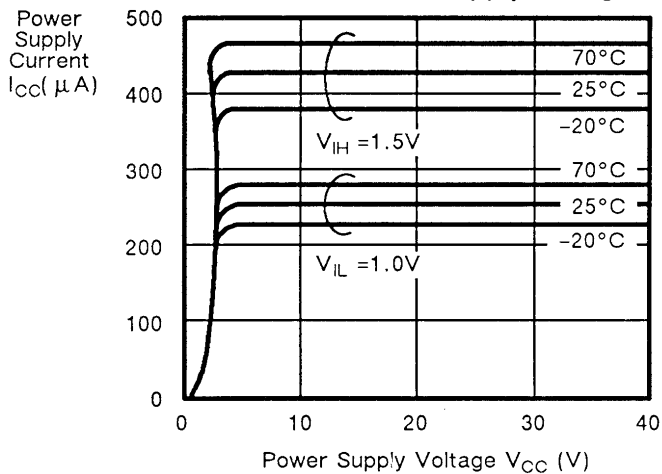
$$V_R \cong V_{TH} (\cong 1.20V)$$

$$R_2 // R_3 = \frac{R_2 R_3}{R_2 + R_3}$$

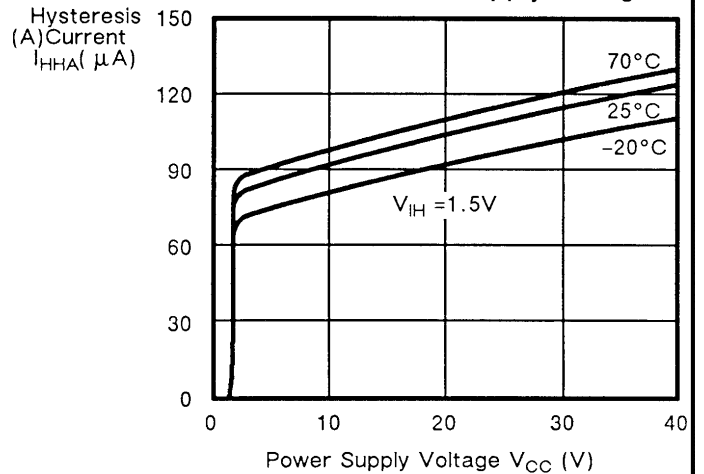
$$R_5 // R_6 = \frac{R_5 R_6}{R_5 + R_6}$$

# TYPICAL PERFORMANCE CHARACTERISTICS

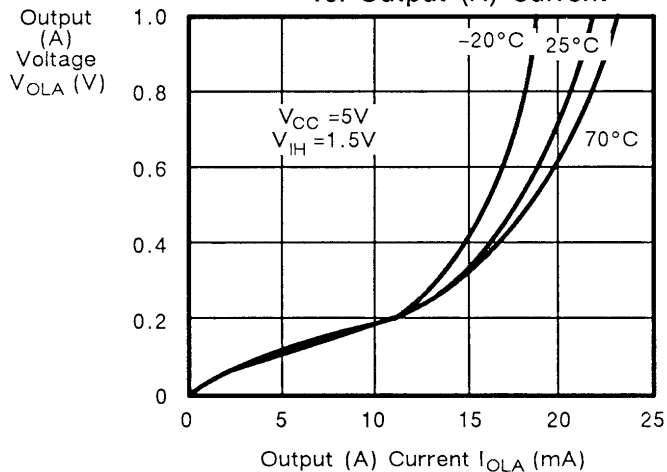
**Fig. 3 – Power Supply Current vs Power Supply Voltage**



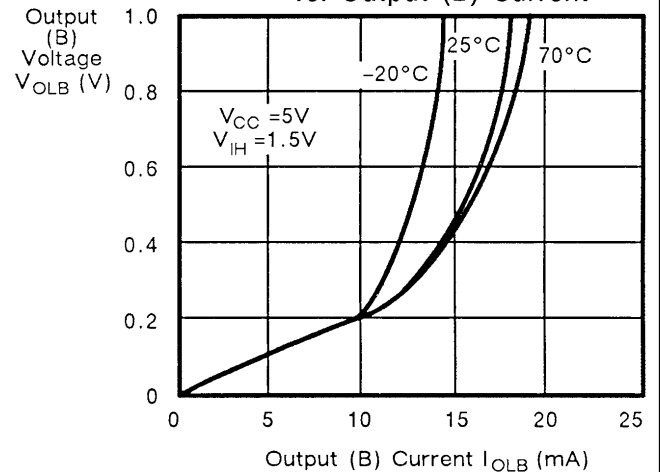
**Fig. 4 – Hysteresis (A) Current vs Power Supply Voltage**



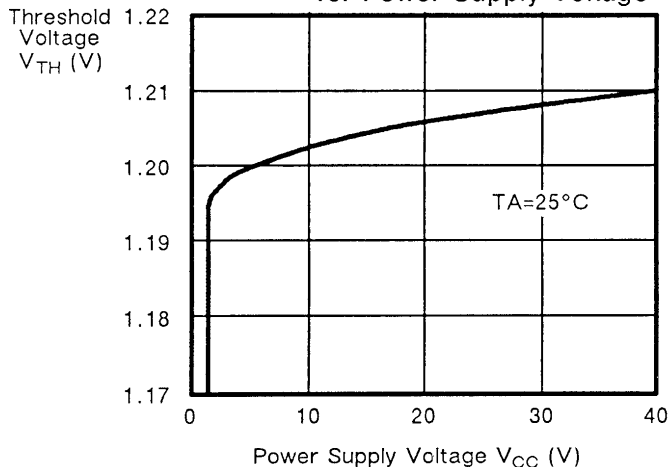
**Fig. 5 – Output (A) Voltage vs. Output (A) Current**



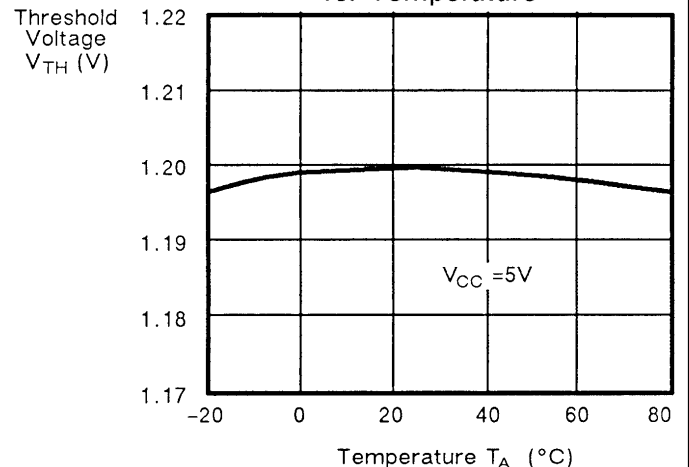
**Fig. 6 – Output (B) Voltage vs. Output (B) Current**



**Fig. 7 – Threshold Voltage vs. Power Supply Voltage**

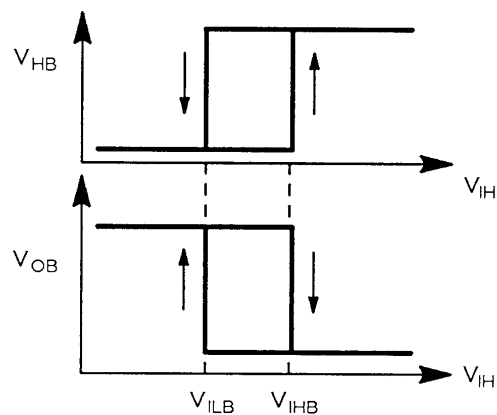
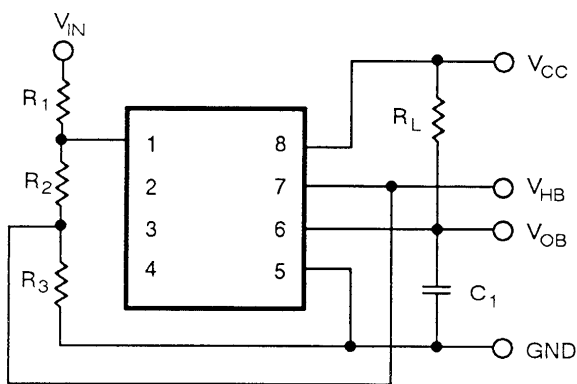
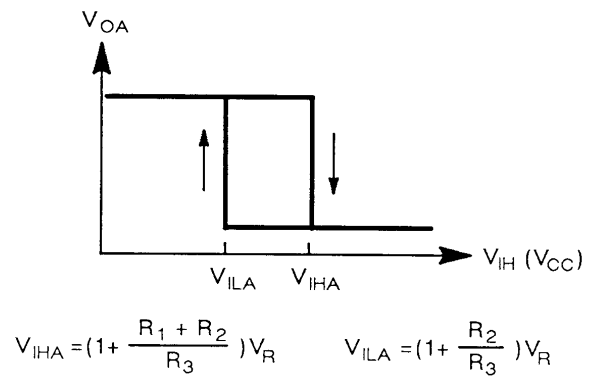
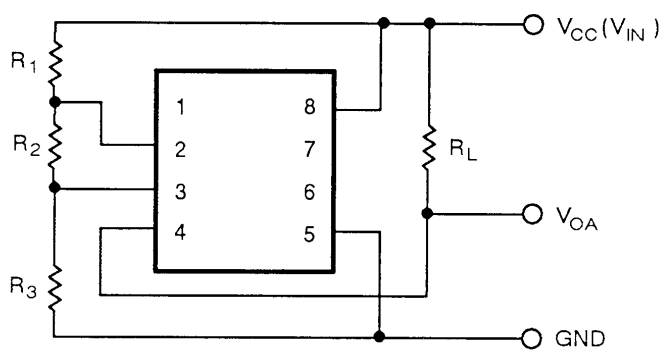


**Fig. 8 – Threshold Voltage vs. Temperature**



## APPLICATION EXAMPLES

Figure 9. Addition of Hysteresis

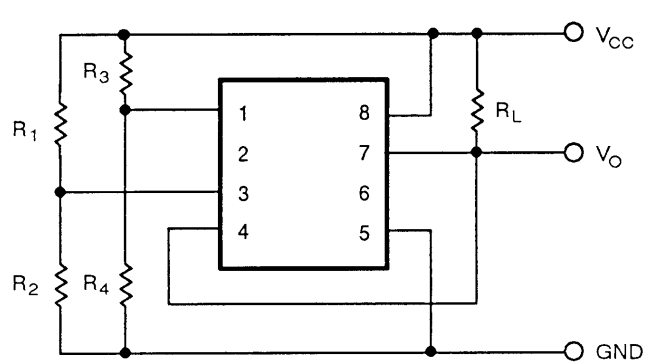


Note: All calculations occur with the output voltage at 0. The hysteresis values are adjusted for load condition and saturation voltage.

$$V_{IHB} = \left(1 + \frac{R_1}{R_2}\right) V_R \quad V_{ILB} = \left(1 + \frac{R_1}{R_2 + R_3}\right) V_R$$

## APPLICATION EXAMPLES (Continued)

Figure 10. Voltage Detection for Alarm



For hysteresis, a positive feedback from pin 2 or 7 is required.

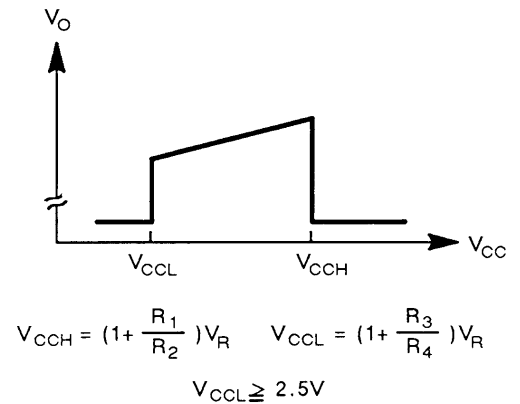
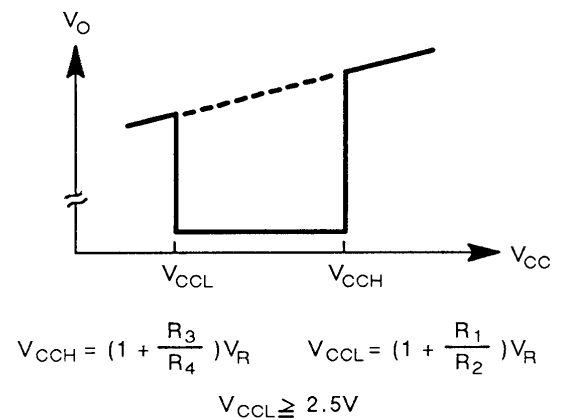
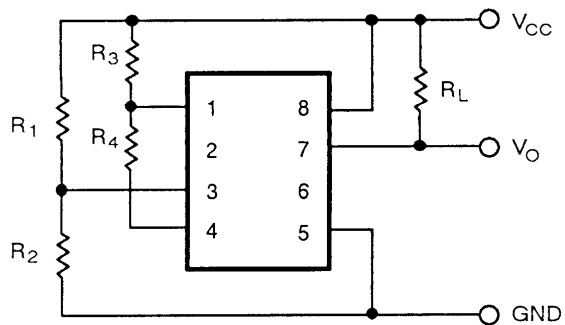


Figure 11. Voltage Detection for Alarm

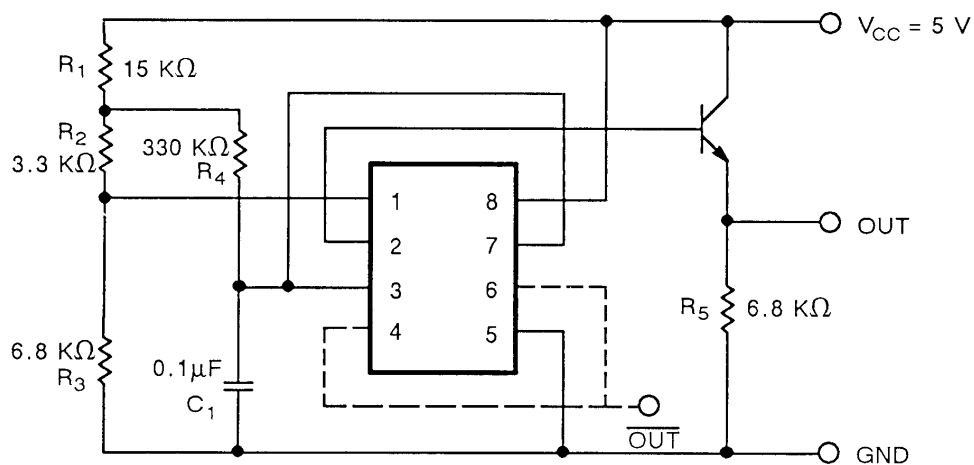


The circuit diagram shows a 4-bit DAC. A resistor ladder consists of three resistors,  $R_1$ ,  $R_2$ , and  $R_3$ , connected in series between a reference voltage  $V_Z$  and ground. The nodes between the resistors are connected to the inputs of a 4-bit DAC block, labeled 1, 2, 3, and 4. The DAC block is represented by a rectangle with inputs 1, 2, 3, 4 on the left and outputs 8, 7, 6, 5 on the right. The output of the DAC is connected to a buffer amplifier, represented by a triangle with a circle inside. The buffer's input is connected to the DAC output, and its output is connected to the  $V_{CC}$  supply. The ground connection is labeled GND.

$$V_Z \simeq (1 + \frac{R_2}{R_3}) V_R$$

$$\frac{V_Z}{R_2 + R_3} \leq \frac{V_{CC} - V_Z}{R_1} \leq 6\text{mA}$$

### Figure 13. Recovery Reset Circuit





## APPLICATION EXAMPLES (Continued)

Figure 14. DC Characteristics

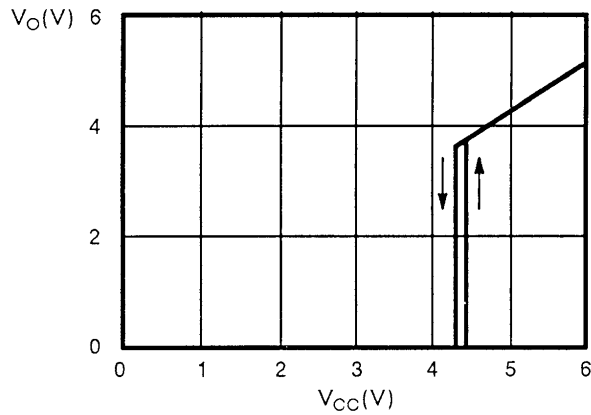
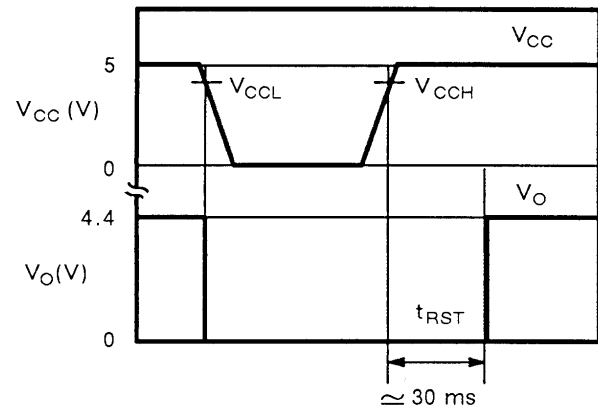


Figure 15. Response Characteristics



- Voltage Threshold Levels ( $V_{CCL}$  and  $V_{CCH}$ ) and Hysteresis Width can be changed by the resistors ( $R_1$  through  $R_4$ ).

$$V_{CCL} = \frac{R_1 + R_2 + R_3}{R_3} V_{TH}$$

$$V_{CCH} = V_{CCL} + \frac{R_1 (R_2 + R_3)}{R_3 R_4} V_{TH}$$

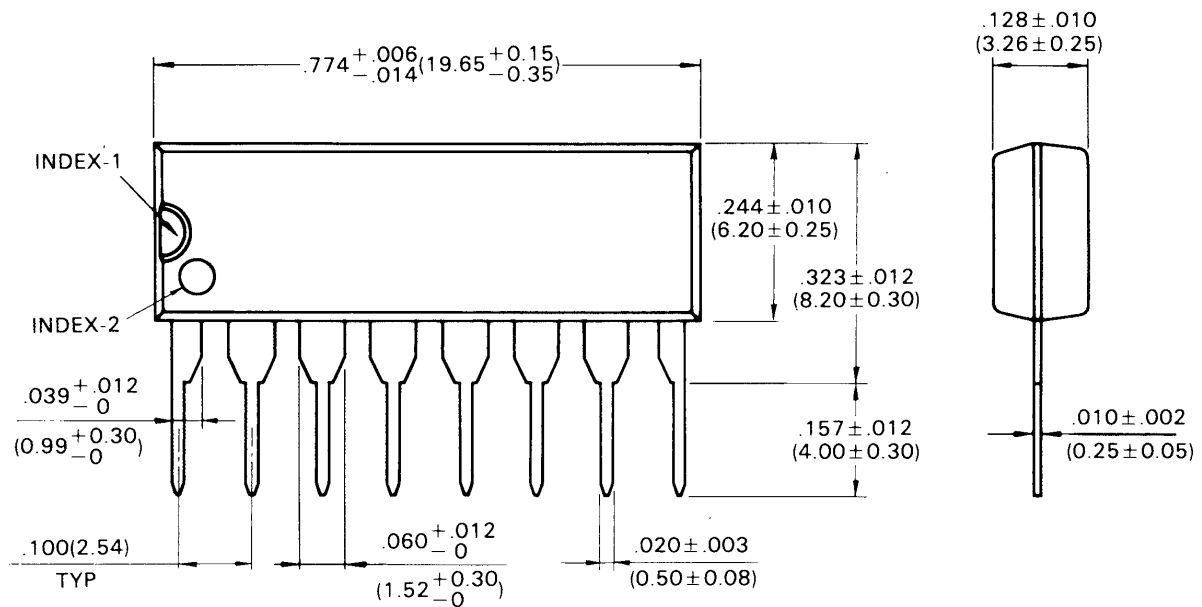
- Power-On Reset Time is provided by the following approximate equation:

$$t_{RST} = -C_1 R_4 \cdot \ln \left\{ 1 - \frac{V_{TH}}{V_{CC}} \left( 1 + \frac{R_1}{R_2 + R_3} \right) \right\}$$

- The recommended value of  $h_{FE}$  of the external transistor is from 50 to 200.
- In the case of an instant power fail, the remaining charge in  $C_1$  effects  $t_{RST}$ .
- If necessary, the reversed output is provided on HYS terminal

## PACKAGE DIMENSIONS

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

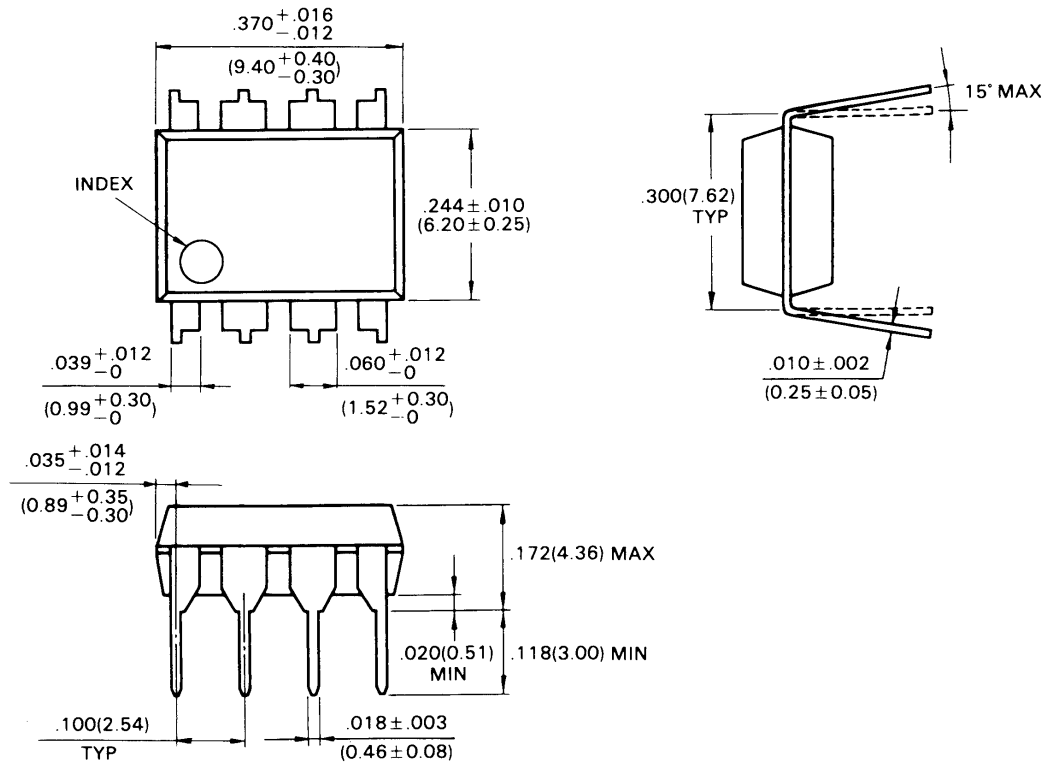


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Dimensions in  
inches (millimeters)

## DIMENSIONS (Continued)

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

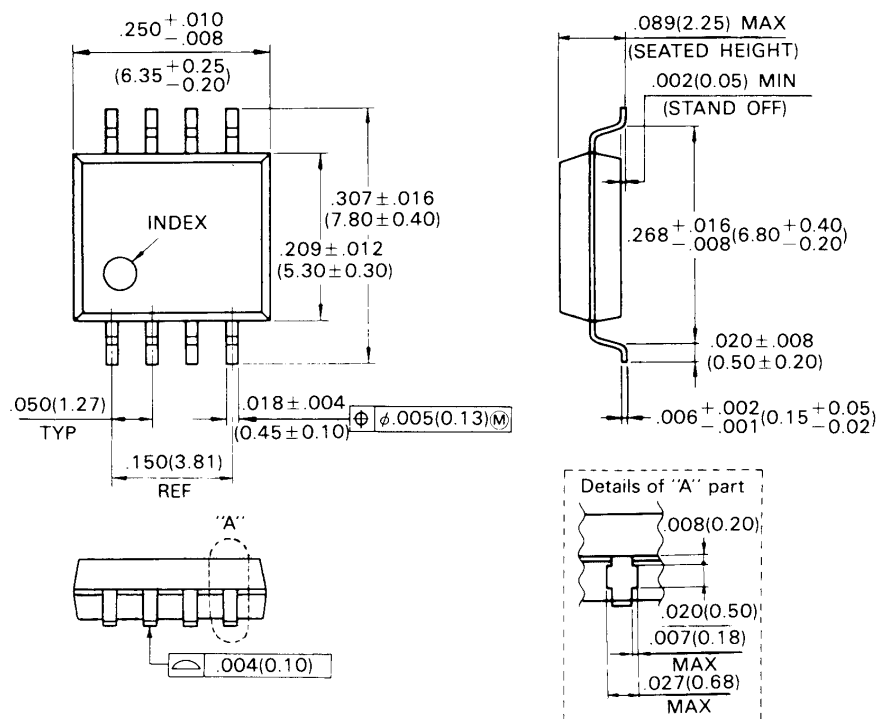


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Dimensions in  
inches (millimeters)

# PACKAGE DIMENSIONS (Continued)

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



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Dimensions in  
inches (millimeters)

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