*ASSP*

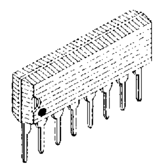
# VOLTAGE DETECTOR

# MB3761

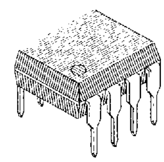
## VOLTAGE DETECTOR

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 low power supply current, the MB3761 is suitable for power supply monitors and battery backup systems.

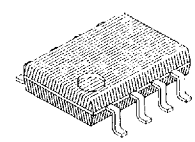
- Wide power supply voltage range: 2.5 V to 40 V
- Low power and small voltage dependency supply current: 250 μA typical.
- Built-in stable low voltage generator: 1.20 V typical.
- Easy-to-add hysteresis characteristics.
- Package: 8-pin Plastic SIP Package (Suffix: -PS)
  8-pin Plastic DIP Package (Suffix: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



PLASTIC PACKAGE
SIP-08P-M03



PLASTIC PACKAGE
DIP-08P-M01



PLASTIC PACKAGE
FPT-08P-M01

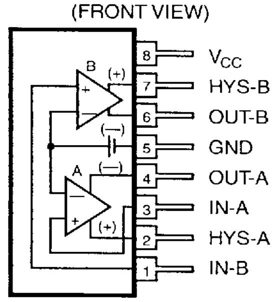
### ABSOLUTE MAXIMUM RATINGS (See NOTE)

| 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 ($T_A \leq 70°C$) | mW |
| Storage Temperature | $T_{STG}$ | -55 to 125 | °C |

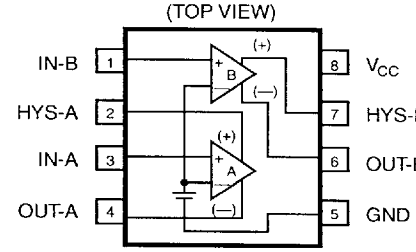
**NOTE:** Permanent device damage may occur if **ABSOLUTE MAXIMUM RATINGS** are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

### PIN ASSIGNMENT

(FRONT VIEW)

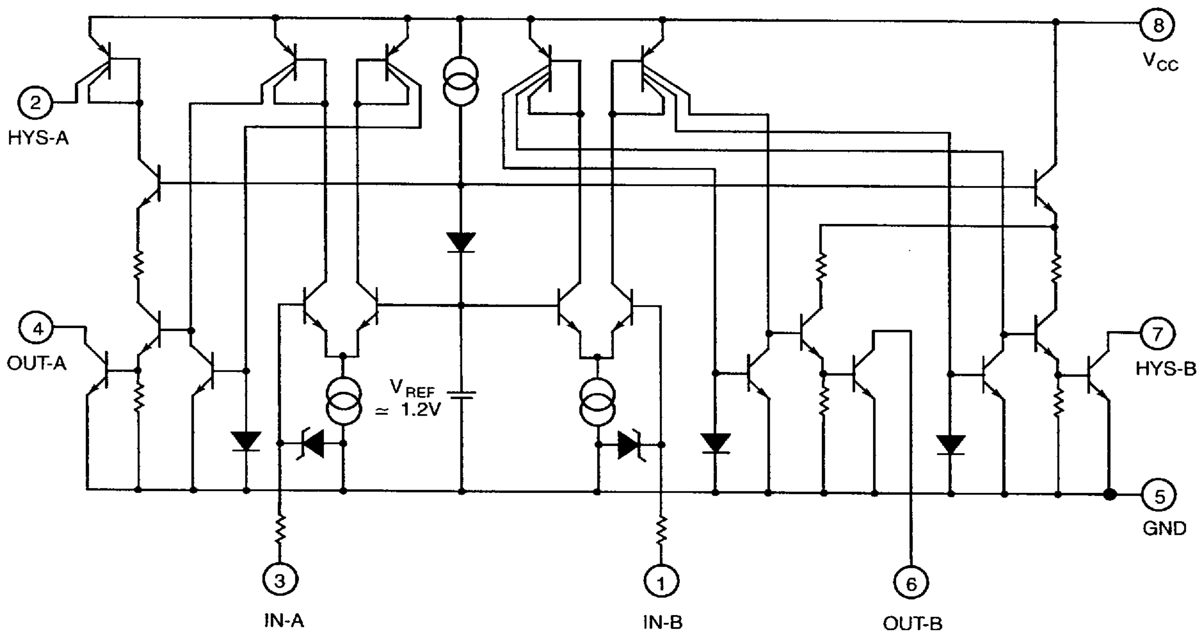



(TOP VIEW)




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

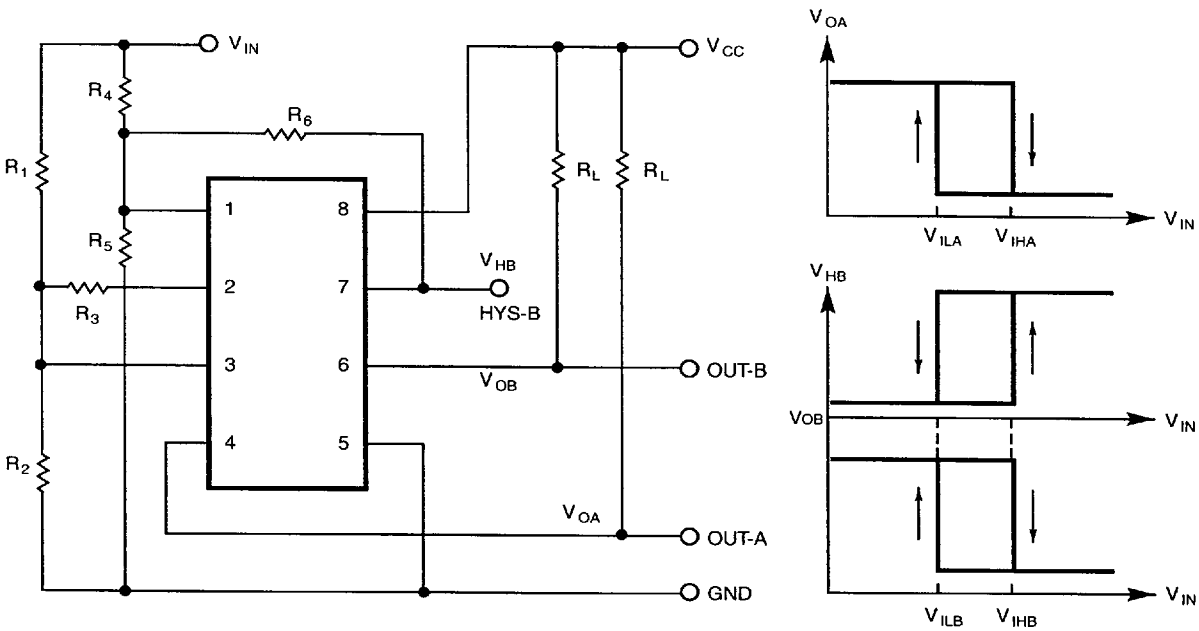
$T_A$=25°C, $V_{CC}$=5V

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



3749756 0025452 769

**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)

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

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

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

## ■ TYPICAL PERFORMANCE CHARACTERISTICS

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

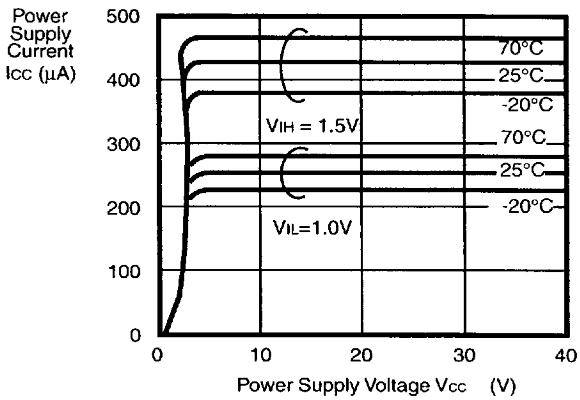



**Fig. 4 - Hysteresis (A) Current vs Power Supply Voltage**

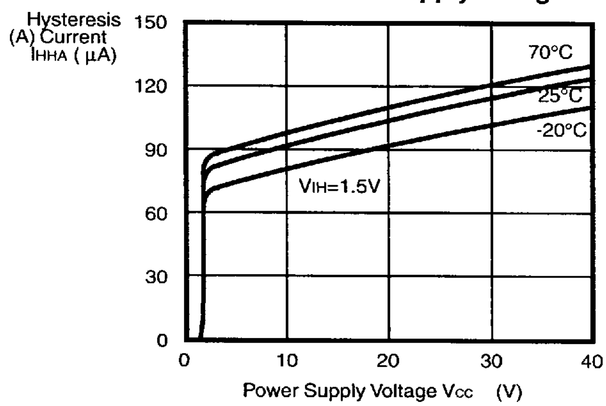



**Fig. 5 - Output (A) Voltage vs. Output (A) Current**

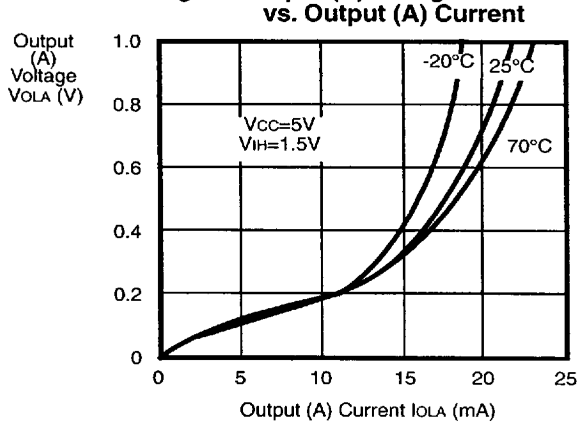



**Fig. 6 - Output (B) Voltage vs. Output (B) Current**

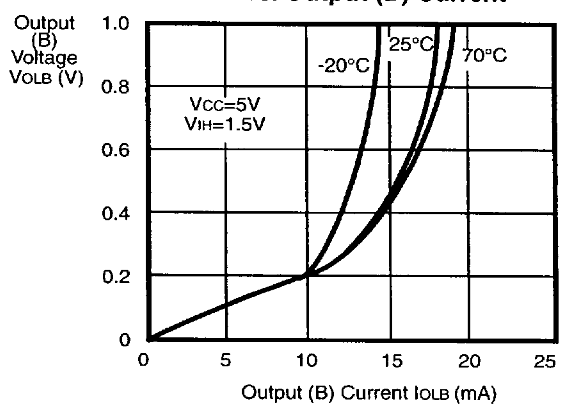



**Fig. 7 - Threshold Voltage vs. Power Supply Voltage**

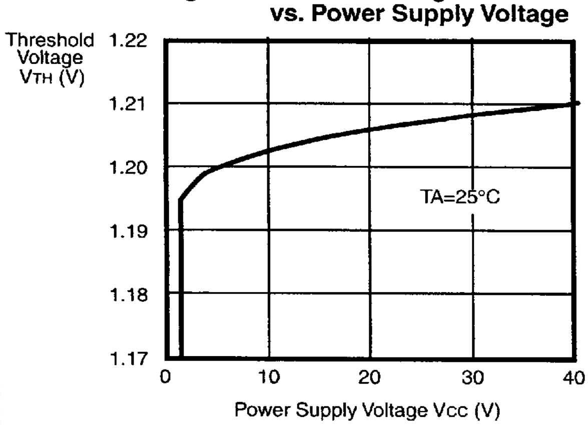
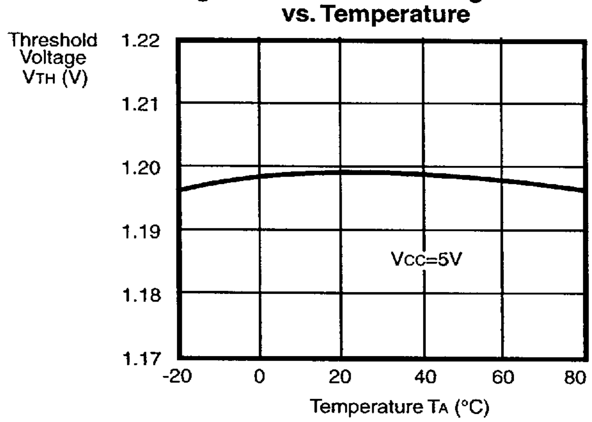
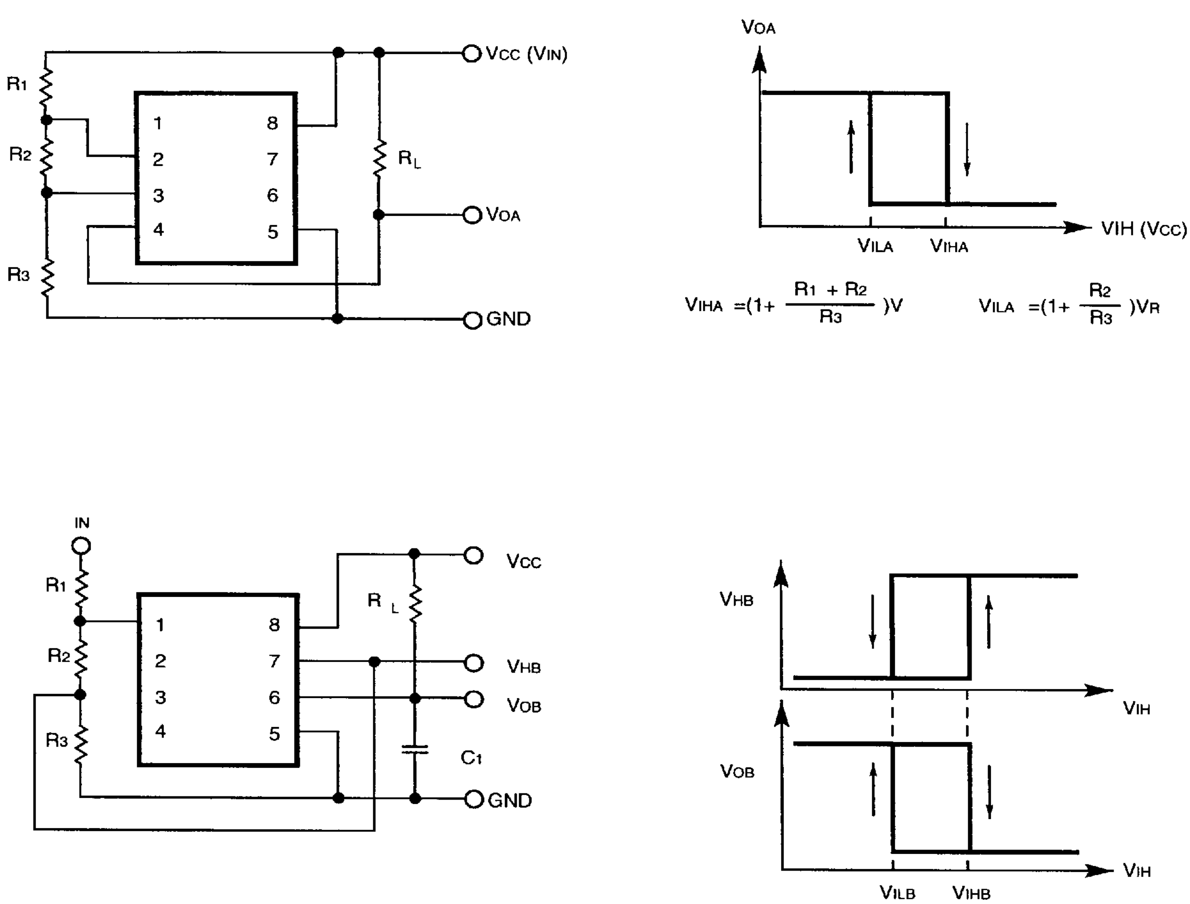



**Fig. 8 - Threshold Voltage vs. Temperature**



## ■ APPLICATION EXAMPLES

**Figure 9. Addition of Hysteresis**



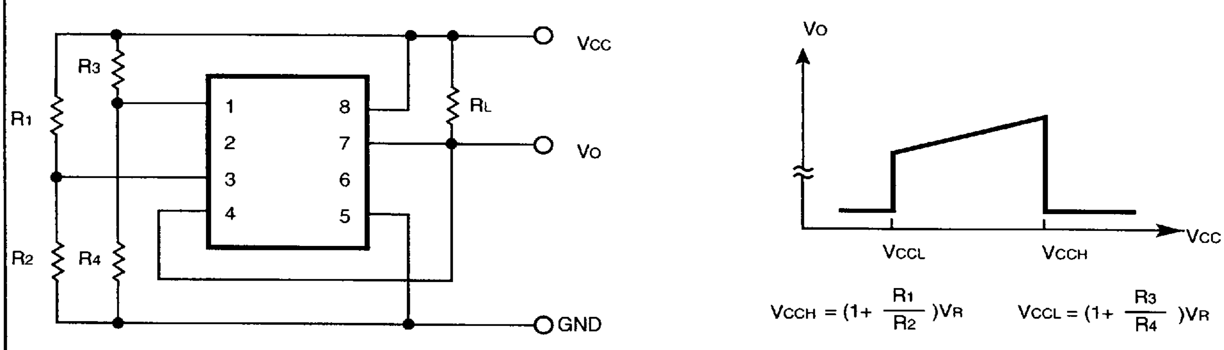

$V_{IHA} = (1 + \frac{R_1 + R_2}{R_3})V$ $\quad V_{ILA} = (1 + \frac{R_2}{R_3})V_R$

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

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

## ■ APPLICATION EXAMPLES (Continued)

**Figure 10. Voltage Detection for Alarm**

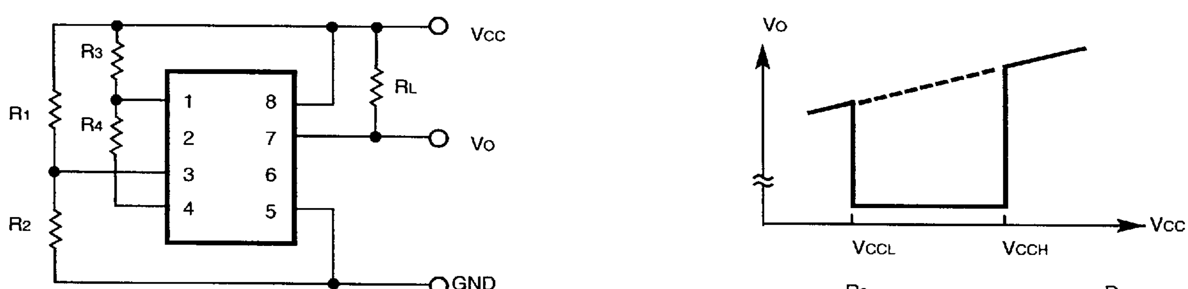



$V_{CCH} = (1 + \frac{R_1}{R_2})V_R$ $\quad V_{CCL} = (1 + \frac{R_3}{R_4})V_R$

$V_{CCL} \geq 2.5\ V$

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

**Figure 11. Voltage Detection for Alarm**

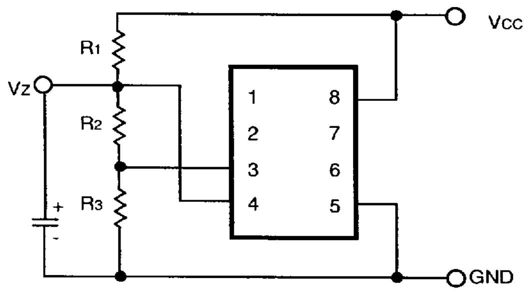



$V_{CCH} = (1 + \frac{R_3}{R_4})V_R$ $\quad V_{CCL} = (1 + \frac{R_1}{R_2})V_R$

$V_{CCL} \geq 2.5\ V$

## ■ APPLICATION EXAMPLES (Continued)

**Figure 12. Programmable Zener**

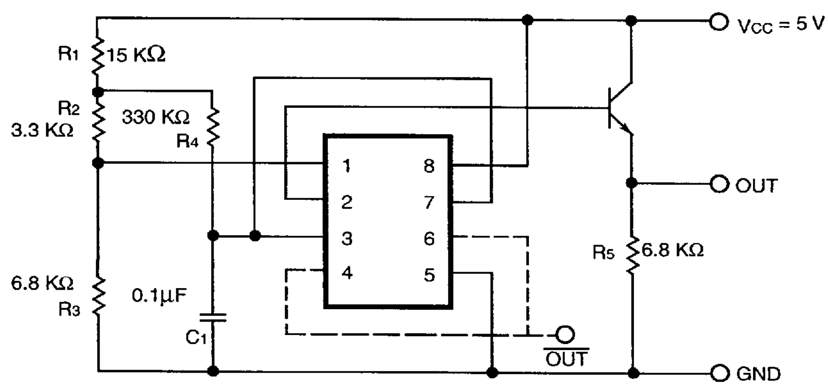



$$V_Z \doteqdot (1+\frac{R_2}{R_3})V_R$$

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

Channel B can be used independently.

**Figure 13. Recovery Reset Circuit**






3749756 0025457 240

## ■ PACKAGE DIMENSIONS

**Figure 14. DC Characteristics**

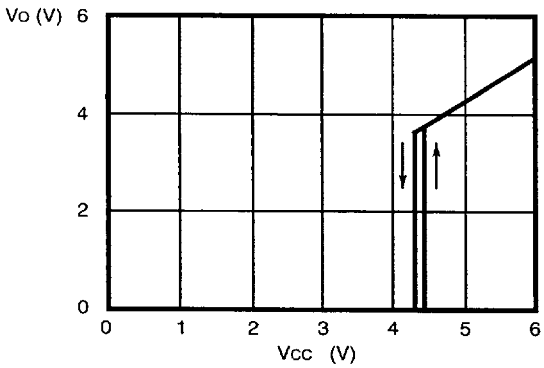
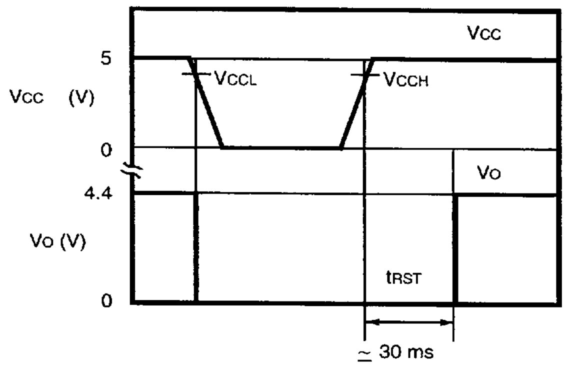



**Figure 15. Response Characteristics**




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

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

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

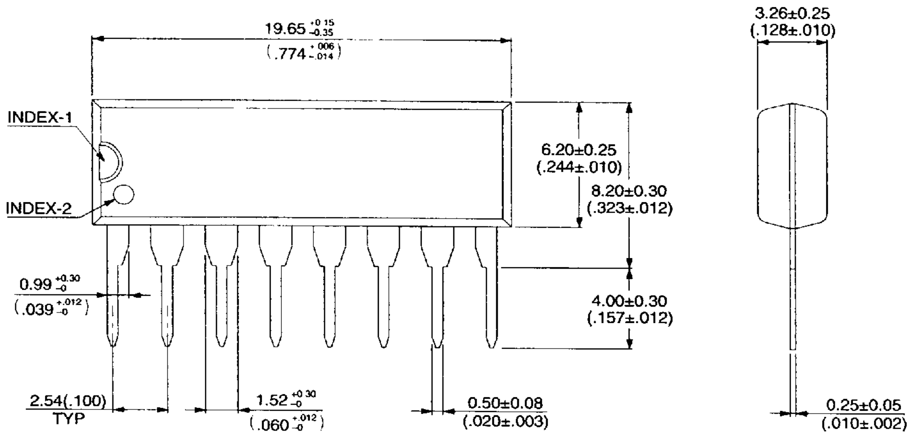
- Power-On Reset Time is provided by the following approximate equation:

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

- 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 (Continued)

8 pin, Plastic SIP
(SIP-08P-M03)

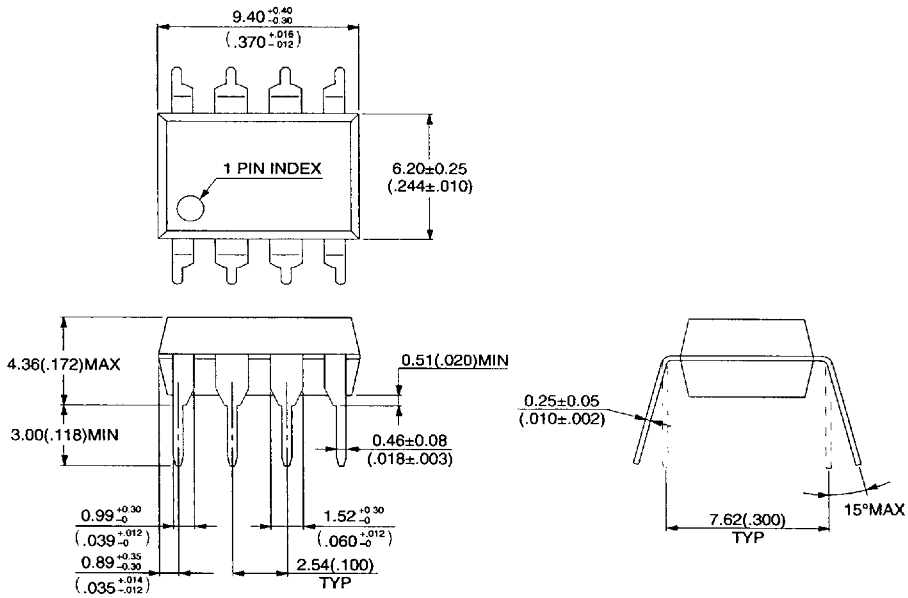





Dimensions in mm (inches).

## ■ PACKAGE DIMENSIONS (Continued)

8 pin, Plastic DIP
(DIP-08P-M01)





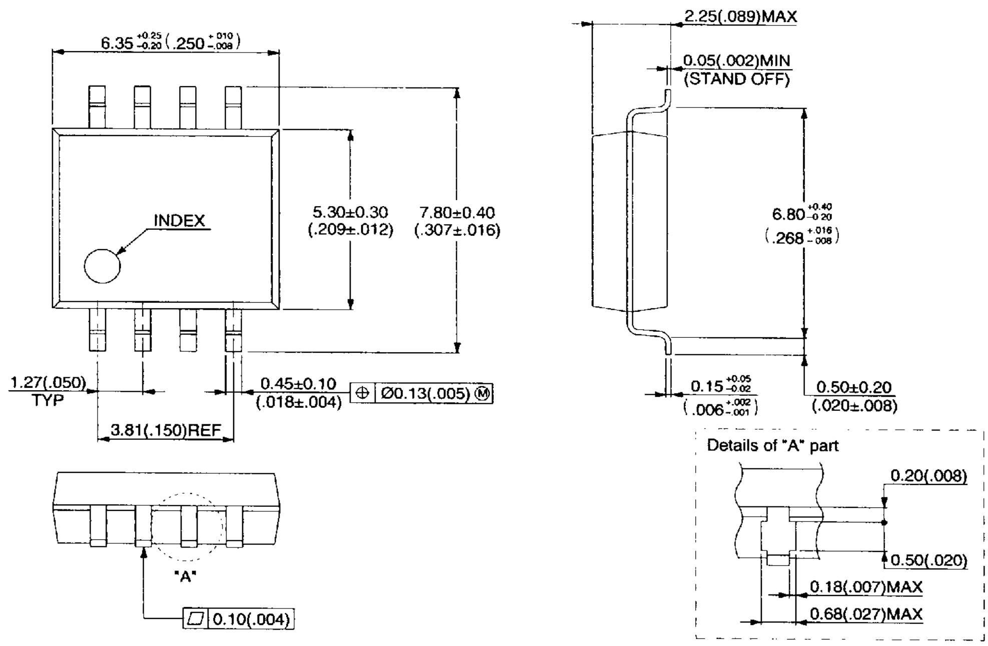

Dimensions in mm (inches).



3749756 0025460 835

## ■ PACKAGE DIMENSIONS (Continued)

8 pin, Plastic SOP
(FPT-08P-M01)






Dimensions in mm(inches).



3749756 0025461 771