

# ASSP VOLTAGE DETECTOR

## MB3761

### VOLTAGE DETECTOR

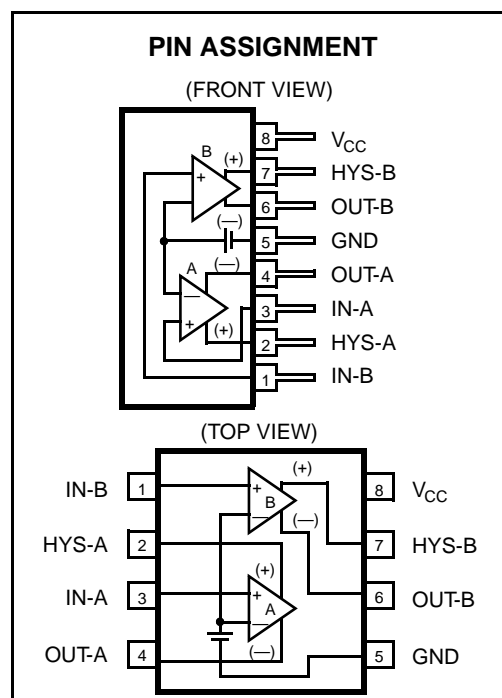
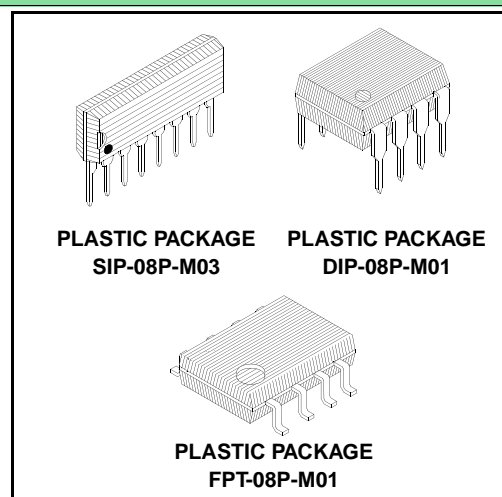
Designed for voltage detector applications, the Fujitsu MB3761 is a dual comparator with a built-in high precision reference voltage generator. Outputs are open-collector outputs and enable use of the OR-connection between both channels. Both channels have hysteresis control outputs. Because of a wide 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  $\mu$ A 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)

### ABSOLUTE MAXIMUM RATINGS (See NOTE)

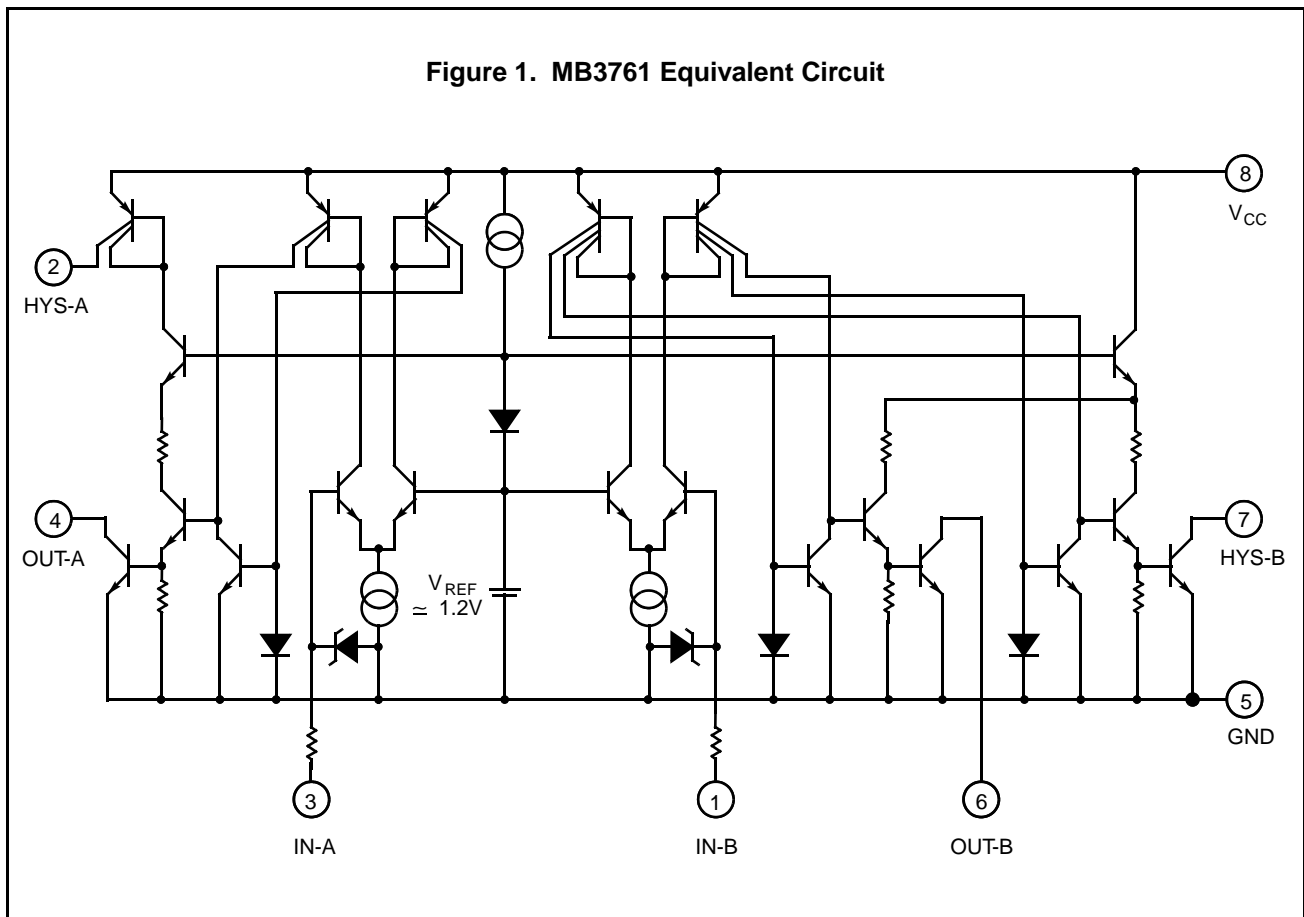
| Rating               | Symbol           | Value                          | Unit |
|----------------------|------------------|--------------------------------|------|
| Power Supply Voltage | V <sub>CC</sub>  | 41                             | V    |
| Output Voltage       | V <sub>O</sub>   | 41                             | V    |
| Output Current       | I <sub>O</sub>   | 50                             | mA   |
| Input Voltage        | V <sub>IN</sub>  | -0.3 to +6.5                   | V    |
| Power Dissipation    | P <sub>D</sub>   | 350<br>(T <sub>A</sub> ≤ 70°C) | mW   |
| Storage Temperature  | T <sub>STG</sub> | -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.

Figure 1. MB3761 Equivalent Circuit



## ■ RECOMMENDED OPERATING CONDITIONS

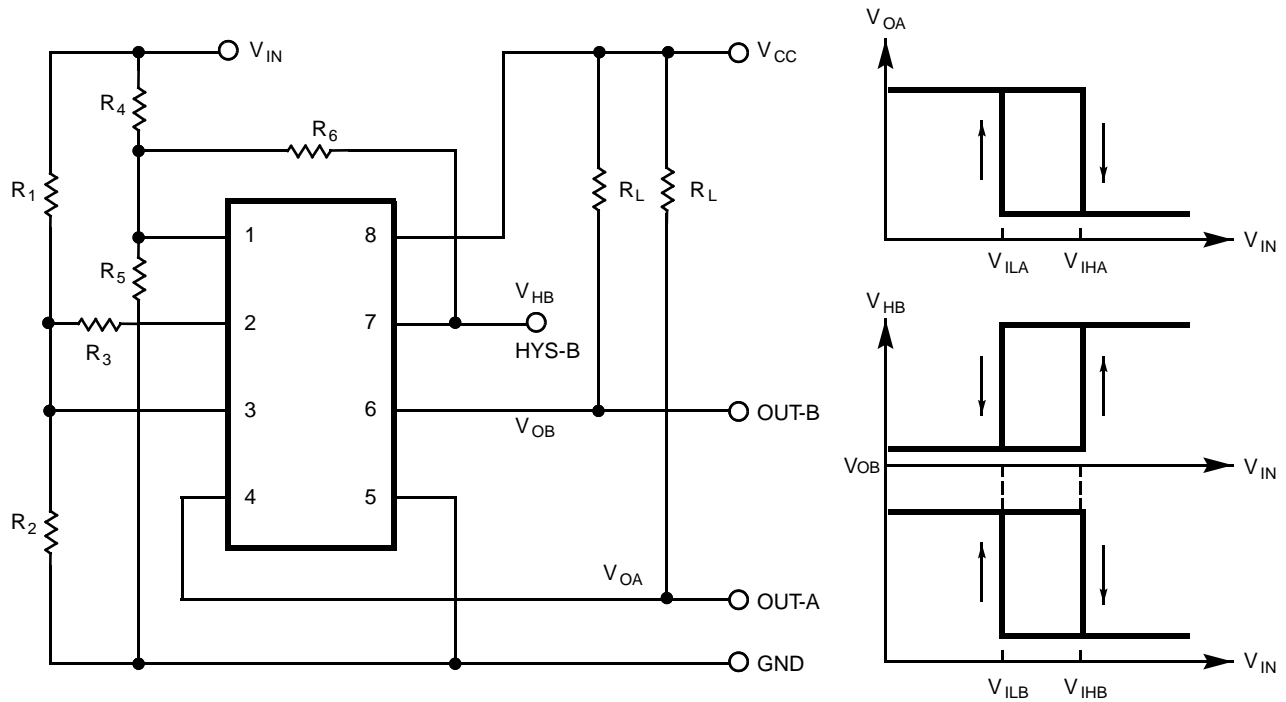
| Parameter               | Symbol | Value     | Unit |
|-------------------------|--------|-----------|------|
| Power Supply Voltage    | VCC    | 2.5 to 40 | V    |
| Operating Temperature   | TA     | -20 to 75 | °C   |
| Output Current at pin 4 | IO4    | 4.5       | mA   |
| Output Current at pin 6 | IO6    | 3.0       | mA   |

## ■ ELECTRICAL CHARACTERISTICS

TA=25°C, VCC=5V

| Parameter   | Designator | Conditions                                  | Values |       |      | Unit  |
|---|------------|---|--------|-------|------|-------|
|   |            |   | Min    | Typ   | Max  |       |
| Power Supply Voltage                                    | ICCL       | VCC=40 V, VIL=1.0 V                         | -      | 250   | 400  | μA    |
|   | ICCH       | VCC=40 V, VIH=1.5 V                         | -      | 400   | 600  | μA    |
| Threshold Voltage                                       | VTH        | IO=2 mA, VO=1 V                             | 1.15   | 1.20  | 1.25 | V     |
| Deviation of Threshold Voltage                          | ΔVTH1      | 2.5 V ≤ VCC ≤ 5.5 V                         | -      | 3     | 12   | mV    |
|   | ΔVTH2      | 4.5 V ≤ VCC ≤ 40 V                          | -      | 10    | 40   | mV    |
| Offset Voltage between Outputs                          | VOOSA      | IOA= 4.5 mA, VOA=2 V<br>IHA= 20 mA, VHA=3 V | -      | 2.0   | -    | mV    |
|   | VOSSB      | IOB=3 mA, VOB=2 V<br>IHB=3 mA, VHB=2 V      | -      | 2.0   | -    | mV    |
| Temperature Coefficient of Threshold Voltage            | α          | -20°C ≤ TA ≤ 70°C                           | -      | ±0.05 | -    | mV/°C |
| Difference Voltage on Threshold Voltage between Channel | ΔVTHAB     |   | -10    | -     | -10  | mV    |
| Input Current   | IIL        | VIL=1.0 V                                   | -      | 5     |      | nA    |
|   | IIH        | VIH=1.5 V                                   | -      | 100   | 500  | nA    |
| Output Leakage Current                                  | IOH        | VO=40 V, VIL=1.0 V                          | -      | -     | 1    | μA    |
| Hysteresis Output Leakage Current                       | IHLA       | VCC=40 V, VHA=0 V,<br>VIL=1.0 V             | -      | -     | 0.1  | μA    |
|   | IHHB       | VHB=40 V, VIH=1.5 V                         | -      | -     | 1    | μA    |
| Output Sink Current                                     | IOLA       | VO=1.0 V, VIH=1.5 V                         | 6      | 12    | -    | mA    |
|   | IOLB       | VO=1.0 V, VIH=1.5 V                         | 4      | 10    | -    | mA    |
| Hysteresis Current                                      | IHHA       | VH=0 V, VIH=1.5 V                           | 40     | 80    | -    | μA    |
|   | IHLB       | VH=1.0 V, VIL=1.0 V                         | 4      | 10    | -    | mA    |
| Output Saturation Voltage                               | VOLA       | IO= 4.5 mA, VIH=1.5 V                       | -      | 120   | 400  | mV    |
|   | VOLB       | IO= 3.0 mA, VIH=1.5 V                       | -      | 120   | 400  | mV    |
| Hysteresis Saturation                                   | VHHA       | IH= 20 μA, VIH=1.5 V                        | -      | 50    | 200  | mV    |
|   | VHLB       | IH= 3.0 mA, VIL=1.0 V                       | -      | 120   | 400  | mV    |
| Output Delay Time                                       | tPHL       | RL=5 KΩ                                     | -      | 2     | -    | μs    |
|   | tPLH       | RL=5 KΩ                                     | -      | 3     | -    | μs    |

Figure 2. Operational Definitions



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

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

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

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

NOTE)

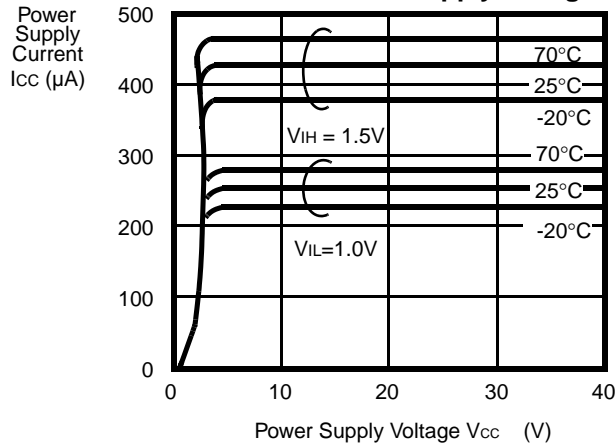
$$V_R \approx V_{TH} (\approx 1.20V)$$

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

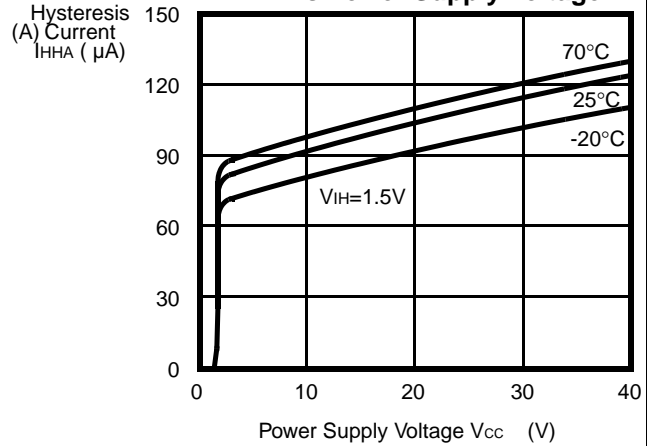
$$R_5 // R_6 = \frac{R_5 R_6}{R_5 + R_6}$$

■ TYPICAL PERFORMANCE CHARACTERISTICS

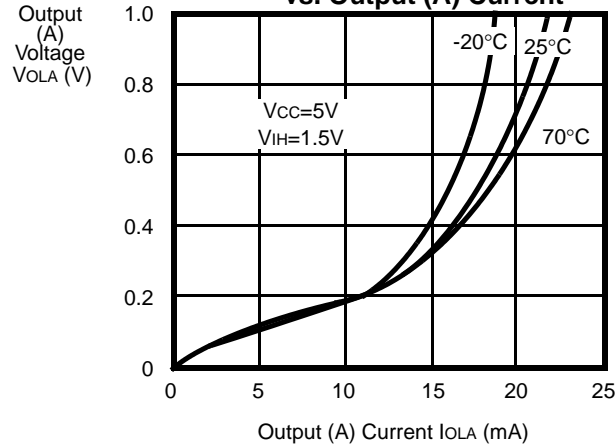
**Fig. 3 - Power Supply Current vs Power Supply Voltage**



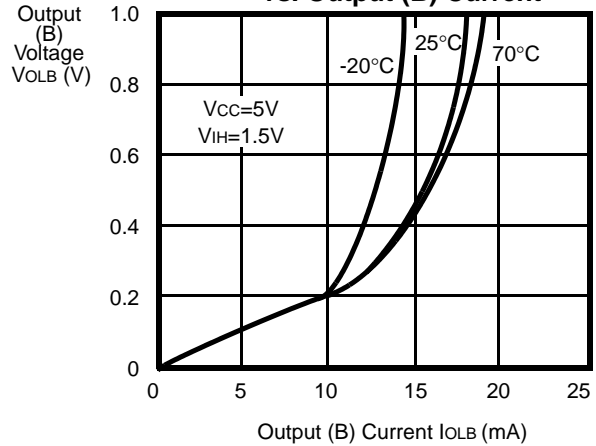
**Fig. 4 - Hysteresis (A) Current vs Power Supply Voltage**



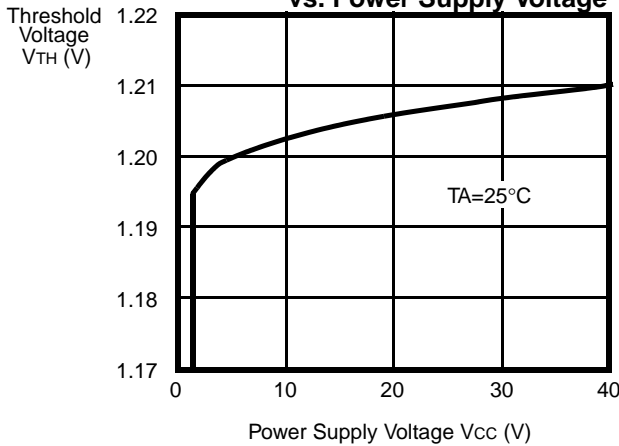
**Fig. 5 - Output (A) Voltage vs. Output (A) Current**



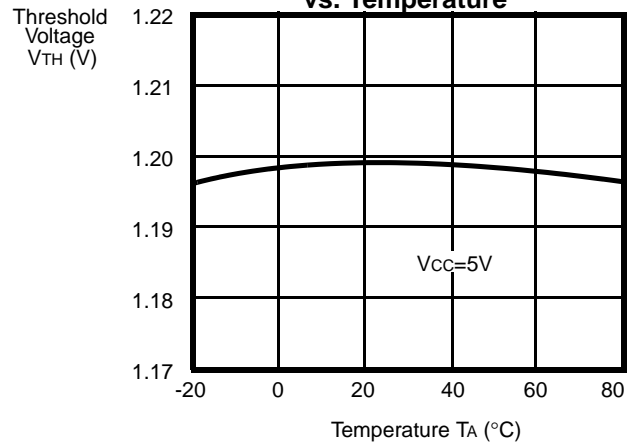
**Fig. 6 - Output (B) Voltage vs. Output (B) Current**



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

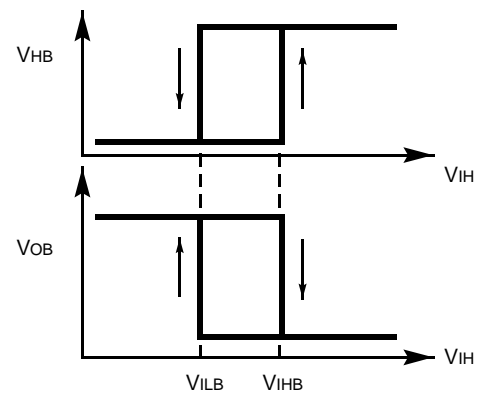
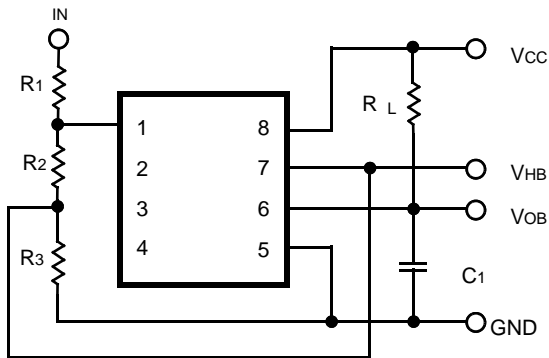
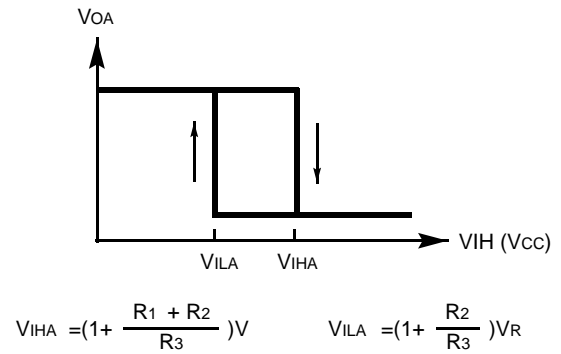
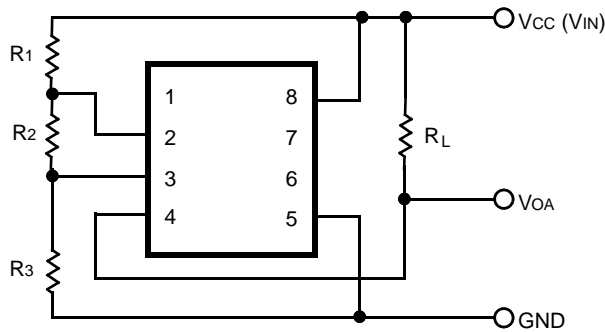


**Fig. 8 - Threshold Voltage vs. Temperature**



## ■ APPLICATION EXAMPLES

Figure 9. Addition of Hysteresis



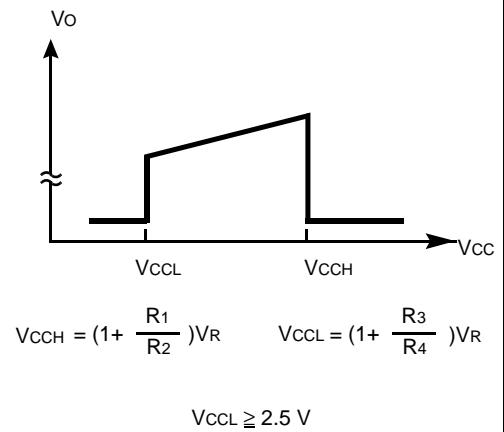
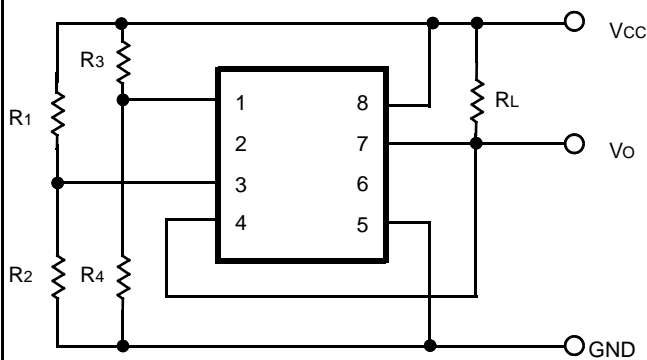
Note: All calculations occur with the output voltage at 0. The hysteresis values are adjusted for load condition and saturation voltage.

$$V_{IH_B} = \left(1 + \frac{R_1}{R_2}\right) V_R$$

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

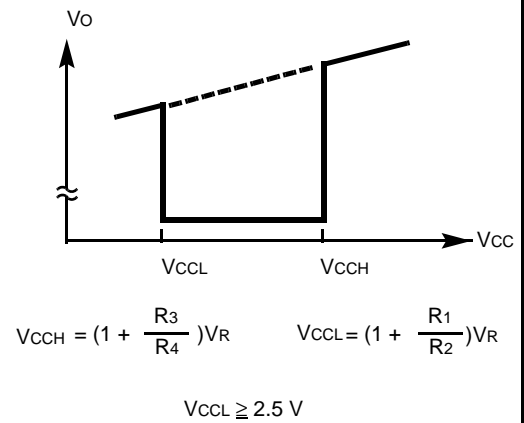
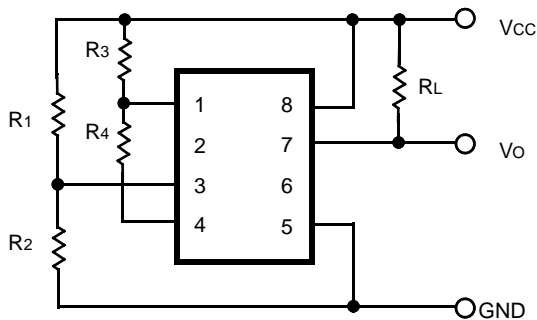
■ APPLICATION EXAMPLES (Continued)

Figure 10. Voltage Detection for Alarm



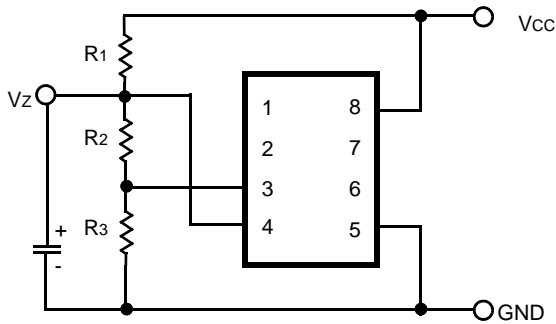
For hysteresis, a positive feedback from pin 2 or 7 is required.

Figure 11. Voltage Detection for Alarm



## ■ APPLICATION EXAMPLES (Continued)

Figure 12. Programmable Zener

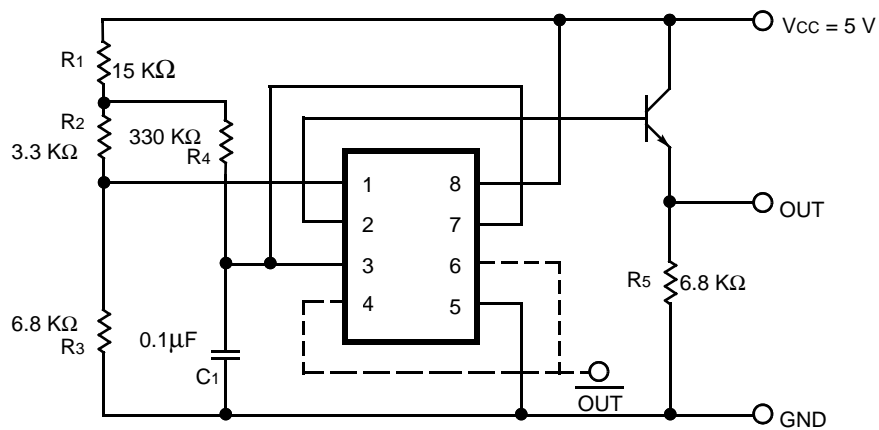


$$V_Z \approx \left(1 + \frac{R_2}{R_3}\right) V_R$$

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

Channel B can be used independently.

Figure 13. Recovery Reset Circuit





■ TYPICAL CHARACTERISTICS

Figure 14. DC Characteristics

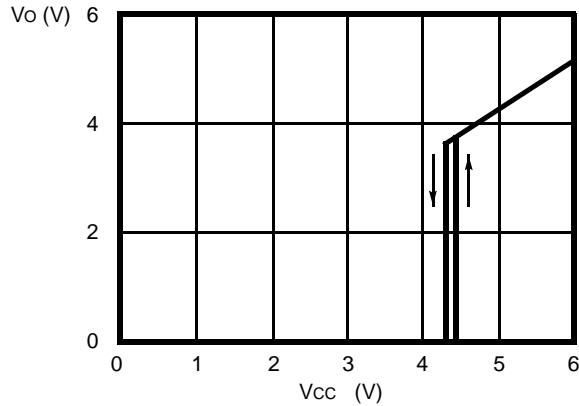
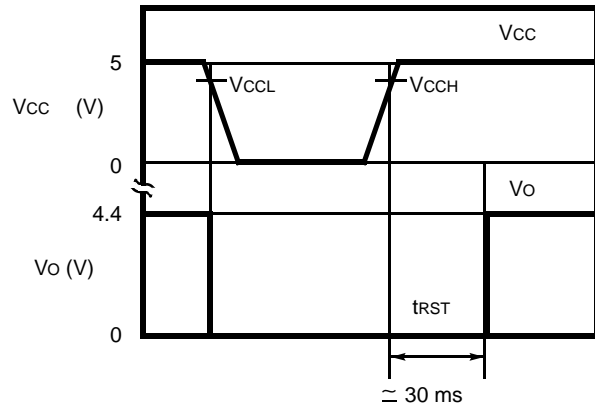


Figure 15. Response Characteristics



- 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:

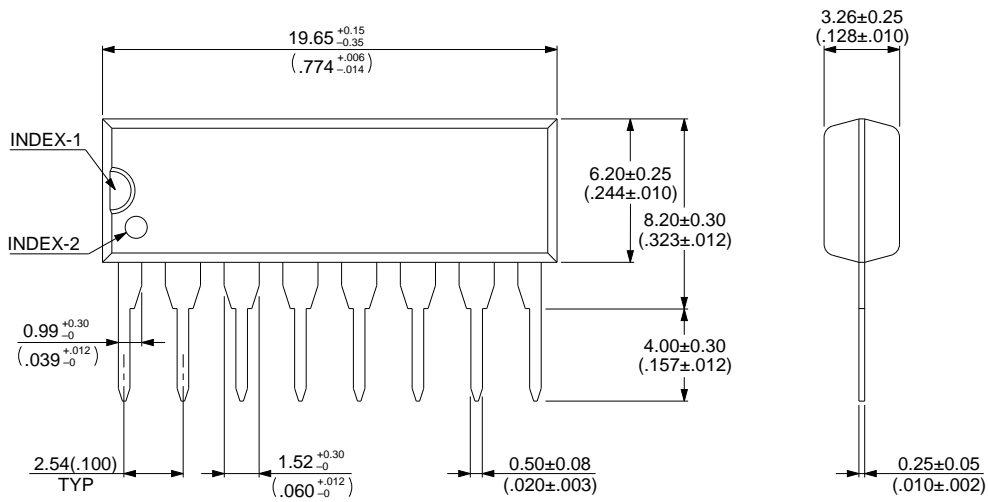
$$t_{RST} = -C_1 R_4 \cdot \ln \left\{ 1 - \frac{V_{TH}}{V_{CC}} \left( 1 + \frac{R_1}{R_2 + R_3} \right) \right\}$$

- The recommended value of hFE 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

# MB3761

## ■ PACKAGE DIMENSIONS (Continued)

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

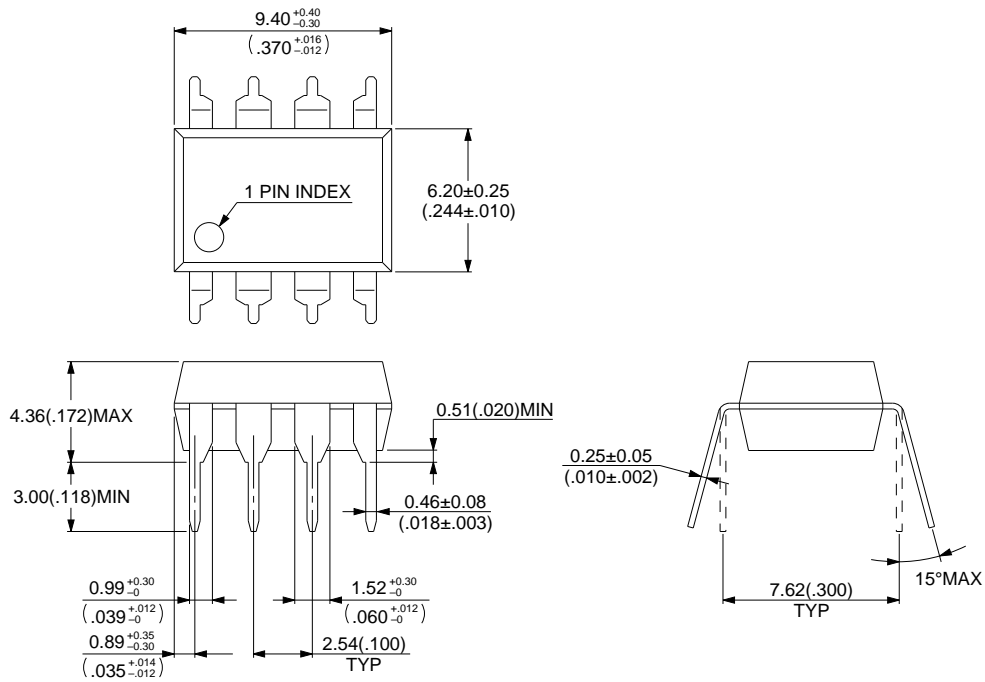


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Dimensions in mm (inches).

## ■ PACKAGE DIMENSIONS (Continued)

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



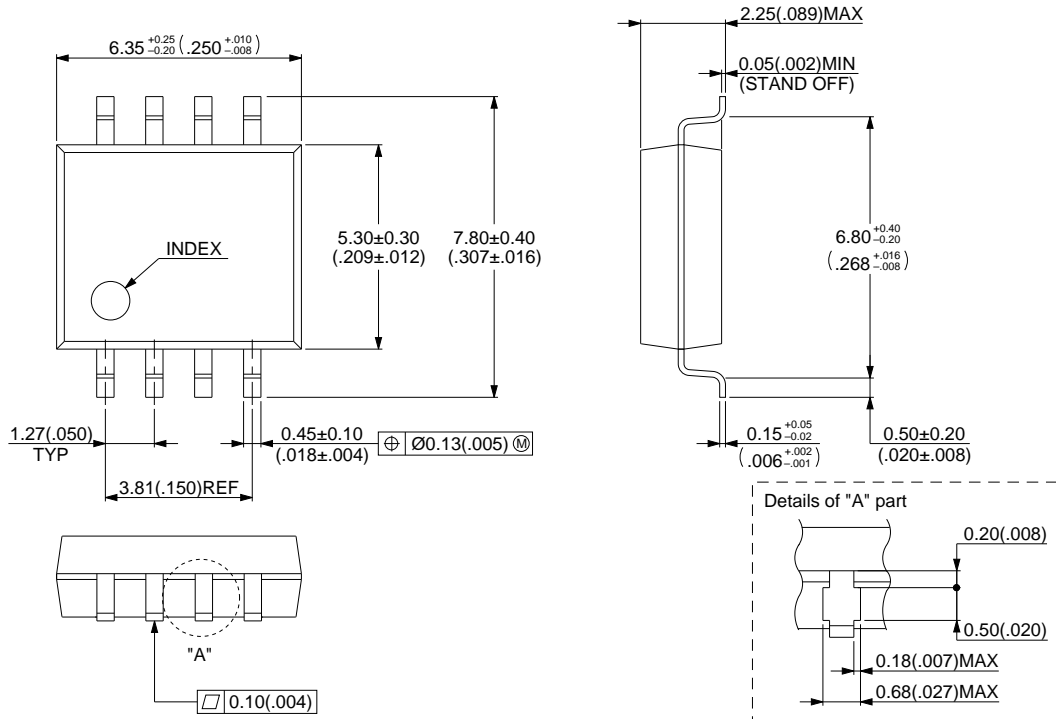
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Dimensions in mm (inches).

# MB3761

## ■ PACKAGE DIMENSIONS (Continued)

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



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Dimensions in mm(inches).

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