

ASSP

BIPOLAR

# VOLTAGE DETECTOR

## MB3761

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

### ■ FEATURES

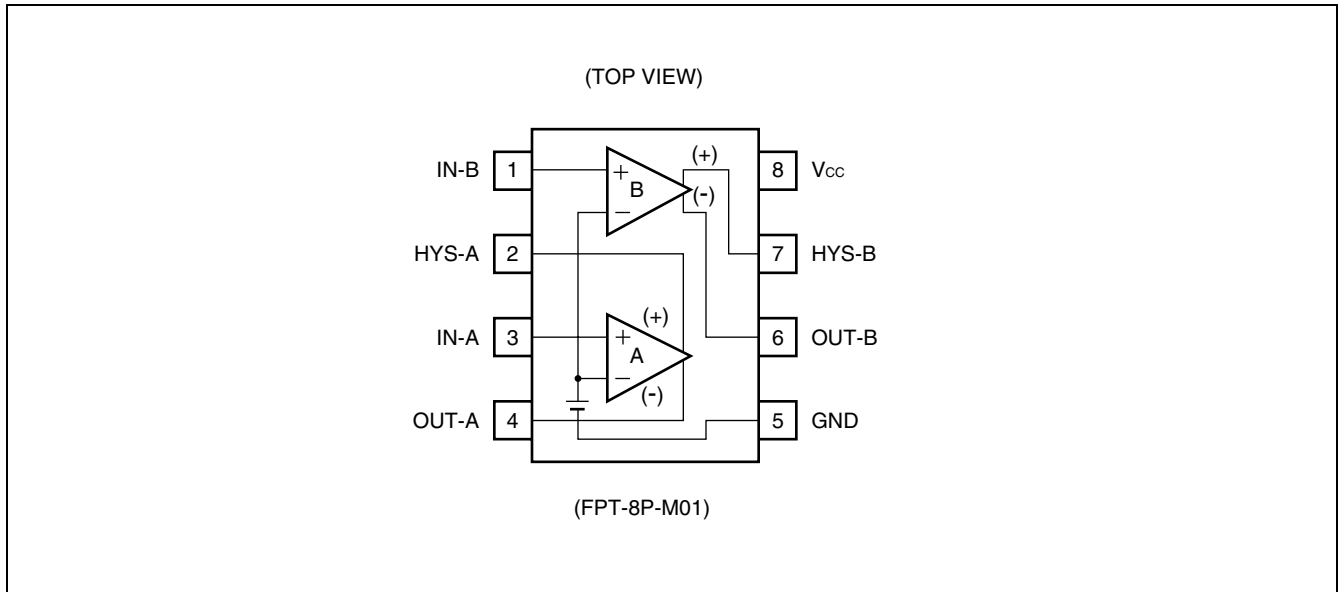
- Wide power supply voltage range: 2.5 V to 40 V
- Low power and small voltage dependency supply current: 250  $\mu$ A Typ
- Built-in stable low voltage generator: 1.20 V Typ
- Easy-to-add hysteresis characteristics.
- One type of package (SOP-8pin : 1 type)

### ■ APPLICATIONS

- Industrial Equipment
- Arcade Amusement etc.

# MB3761

## ■ PIN ASSIGNMENT



## ■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating		Unit
		Min	Max	
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	+ 6.5	V
Power Dissipation	P <sub>D</sub>	—	350 (T <sub>A</sub> ≤ +70°C)	mW
Storage Temperature	T <sub>STG</sub>	- 55	+ 125	°C

WARNING: Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed these ratings.

## ■ RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Value		Unit
		Min	Max	
Power Supply Voltage	V <sub>CC</sub>	2.5	40	V
Operating Ambient Temperature	T <sub>A</sub>	- 20	+ 75	°C
Output Current at pin 4	I <sub>O4</sub>	—	4.5	mA
Output Current at pin 6	I <sub>O6</sub>	—	3.0	mA

WARNING: The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated within these ranges.

Always use semiconductor devices within their recommended operating condition ranges. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their FUJITSU representatives beforehand.

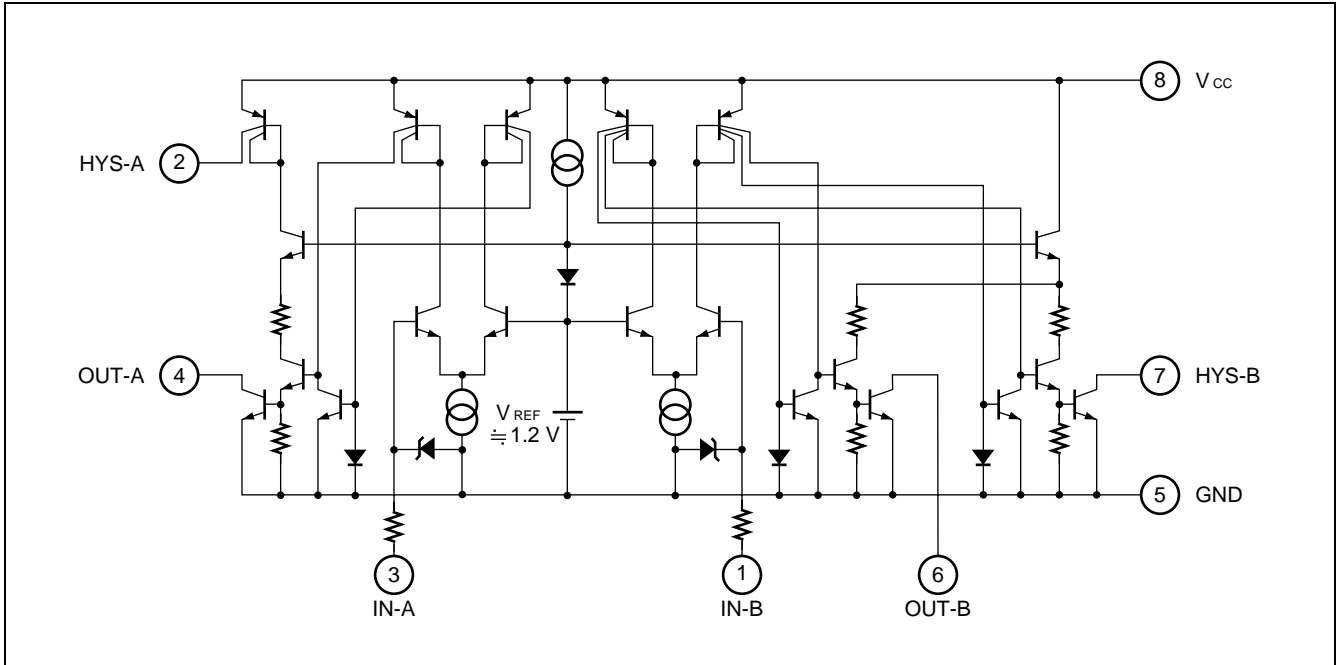
# MB3761

## ■ ELECTRICAL CHARACTERISTICS

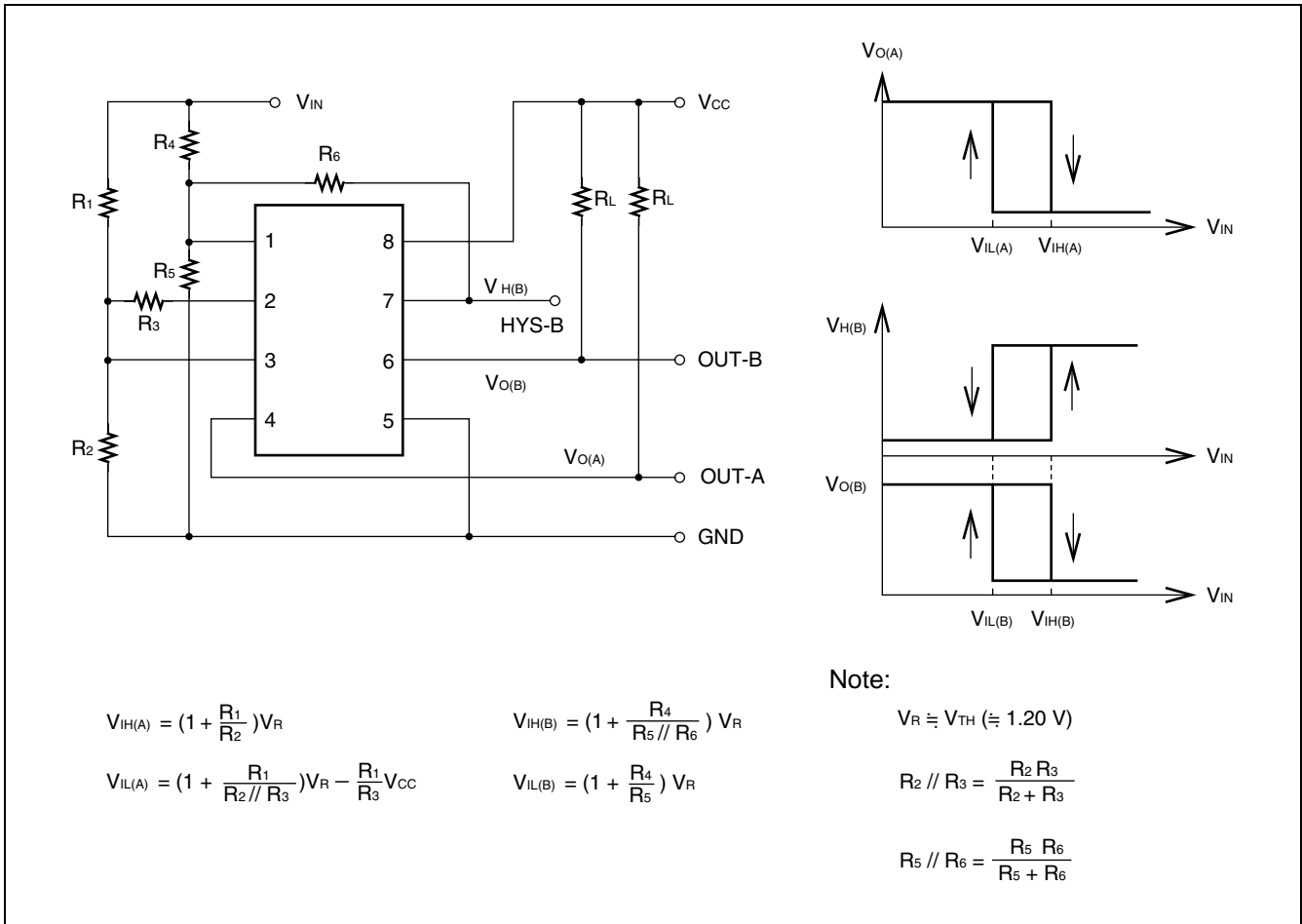
( $T_A=+25^{\circ}\text{C}$ ,  $V_{CC}=5\text{ V}$ )

Parameter	Symbol	Conditions	Value			Unit
			Min	Typ	Max	
Power Supply Voltage	ICCL	$V_{CC}=40\text{ V}$ , $V_{IL}=1.0\text{ V}$	-	250	400	$\mu\text{A}$
	ICCH	$V_{CC}=40\text{ V}$ , $V_{IH}=1.5\text{ V}$	-	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	$V_{OOSA}$	$I_{OA}=4.5\text{ mA}$ , $V_{OA}=2\text{ V}$ , $I_{HA}=20\text{ }\mu\text{A}$ , $V_{HA}=3\text{ V}$	-	2.0	-	mV
	$V_{OSSB}$	$I_{OB}=3\text{ mA}$ , $V_{OB}=2\text{ V}$ , $I_{HB}=3\text{ mA}$ , $V_{HB}=2\text{ V}$	-	2.0	-	mV
Temperature Coefficient of Threshold Voltage	$\alpha$	$-20^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$	-	$\pm 0.05$	-	$\text{mV}/^{\circ}\text{C}$
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	-	$\mu\text{A}$
	$I_{HLB}$	$V_H=1.0\text{ V}$ , $V_{IL}=1.0\text{ V}$	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	$V_{HHA}$	$I_H=20\text{ }\mu\text{A}$ , $V_{IH}=1.5\text{ V}$	-	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	-	$\mu\text{s}$

## EQUIVALENT CIRCUIT

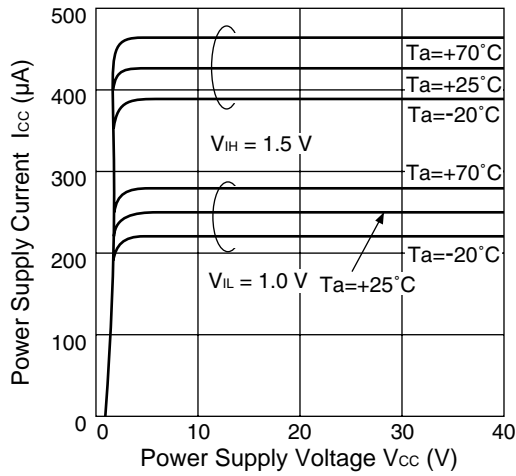


## OPERATIONAL DEFINITIONS

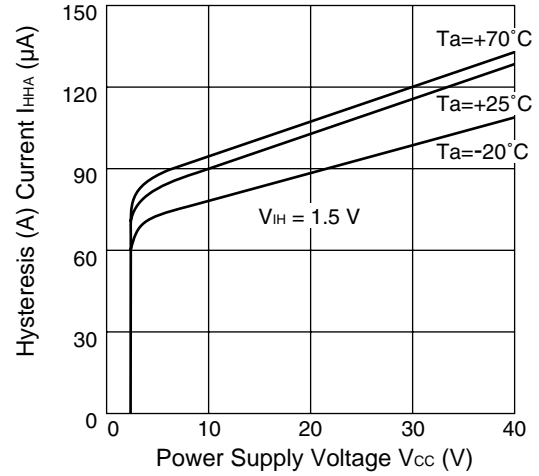


## TYPICAL PERFORMANCE CHARACTERISTICS

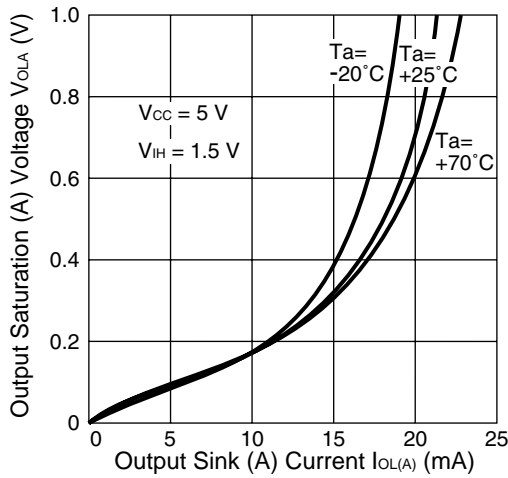
Power Supply Current vs. Power Supply Voltage



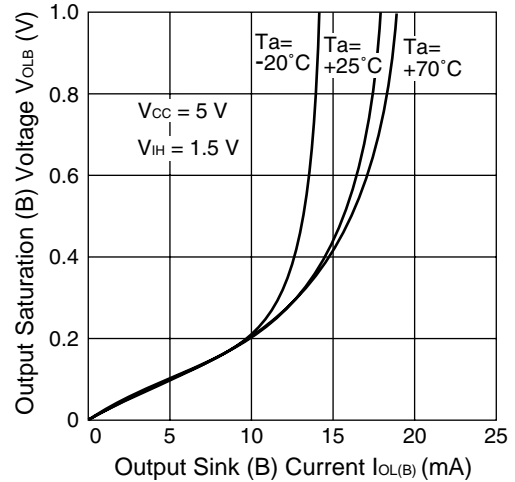
Hysteresis (A) Current vs. Power Supply Voltage



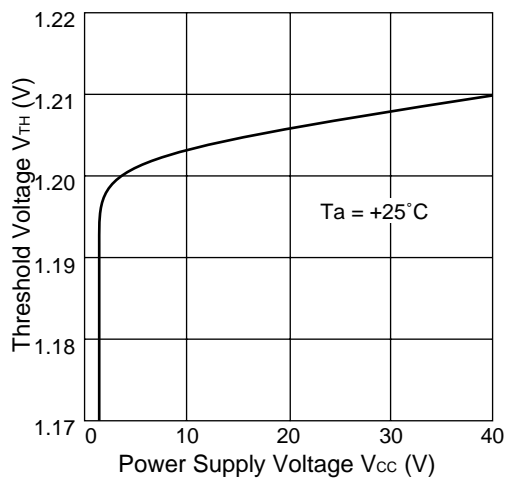
Output Saturation (A) Voltage vs. Output Sink (A) Current



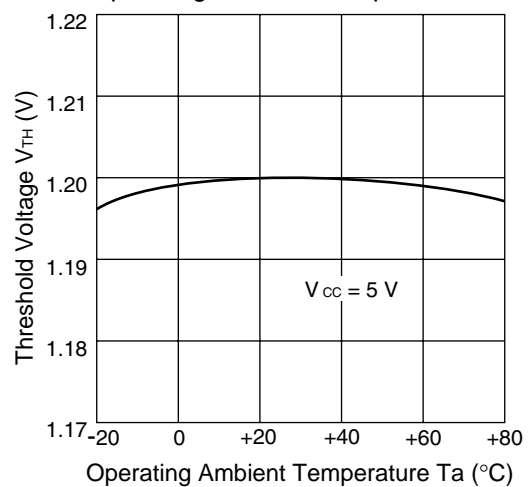
Output Saturation (B) Voltage vs. Output Sink (B) Current



Threshold Voltage vs. Power Supply Voltage

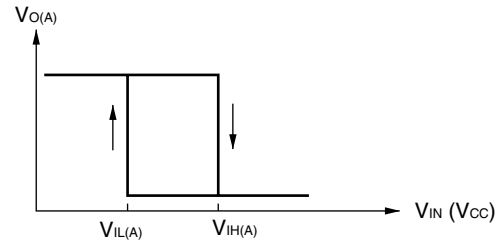
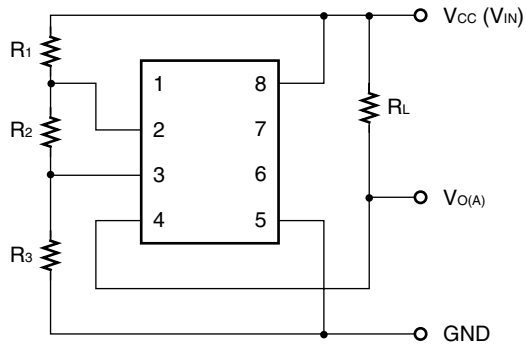


Threshold Voltage vs. Operating Ambient Temperature



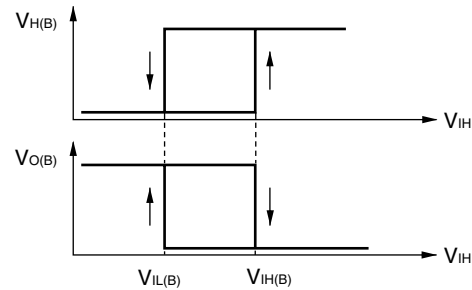
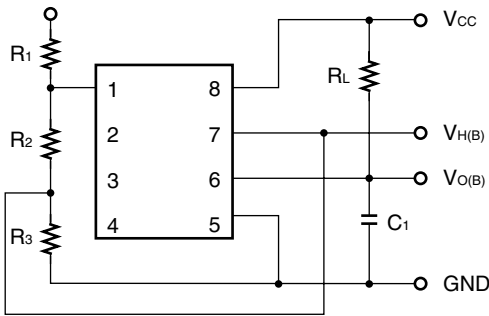
## APPLICATION EXAMPLES

### 1. Addition of Hysteresis



$$V_{IH(A)} \approx \left(1 + \frac{R_1 + R_2}{R_3}\right) V_R$$

$$V_{IL(A)} \approx \left(1 + \frac{R_2}{R_3}\right) V_R$$

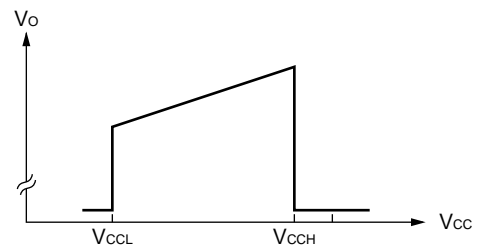
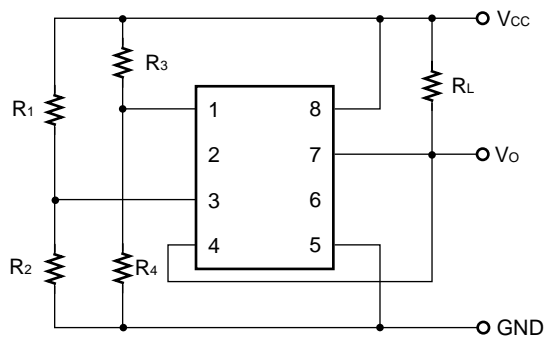


$$V_{IH(B)} \approx \left(1 + \frac{R_1}{R_2}\right) V_R$$

$$V_{IL(B)} \approx \left(1 + \frac{R_1}{R_2 + R_3}\right) V_R$$

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

### 2. Voltage Detection for Alarm



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

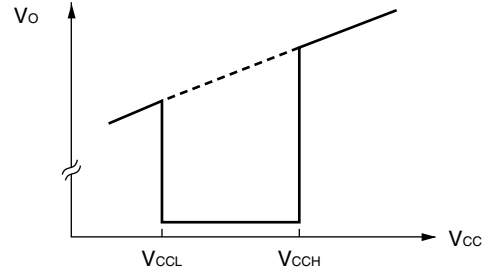
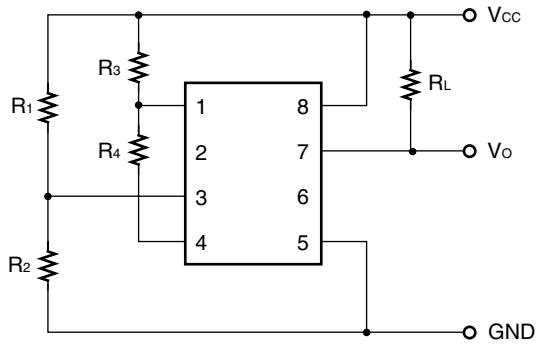
$$V_{CCL} = \left(1 + \frac{R_3}{R_4}\right) V_R$$

$$V_{CCL} \geq 2.5 \text{ V}$$

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

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## 3. Voltage Detection for Alarm

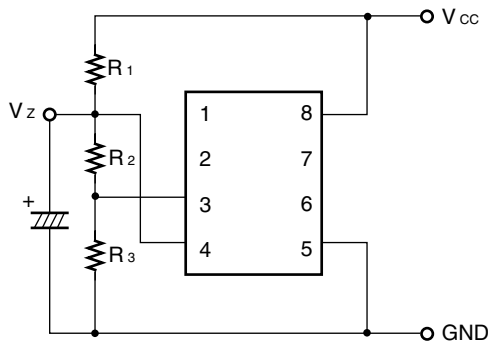


$$V_{CCH} = \left(1 + \frac{R_3}{R_4}\right) V_R$$

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

$$V_{CCL} \geq 2.5 \text{ V}$$

## 4. Programmable Zener



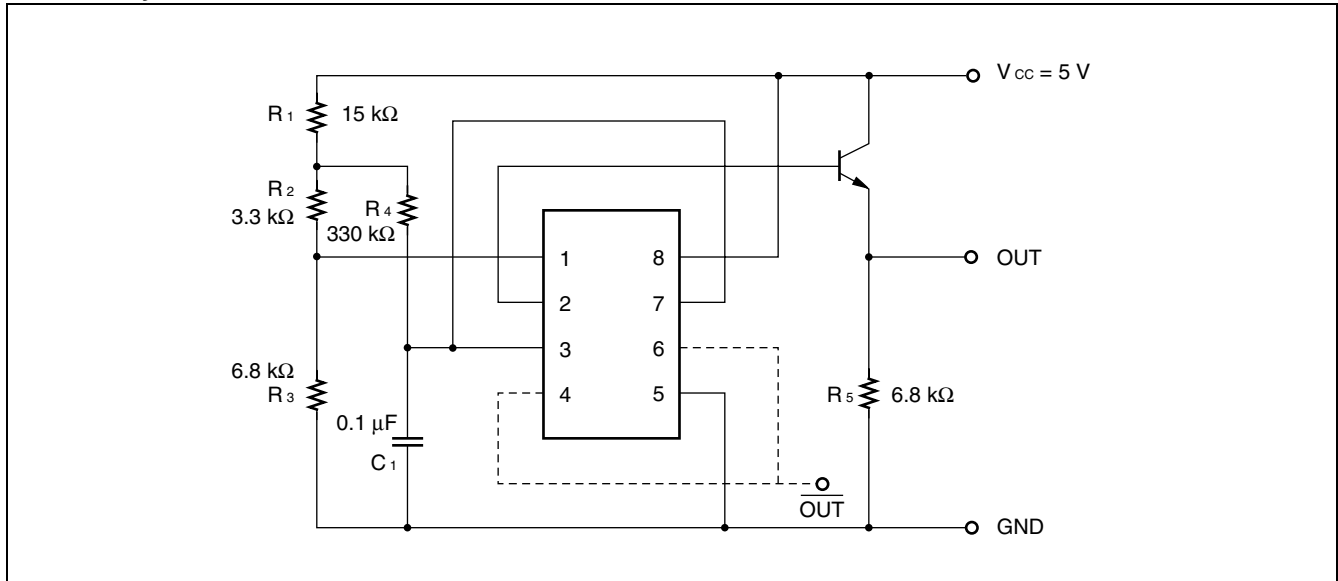
$$V_Z = \left(1 + \frac{R_2}{R_3}\right) V_R$$

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

Note : Channel B can be used independently.

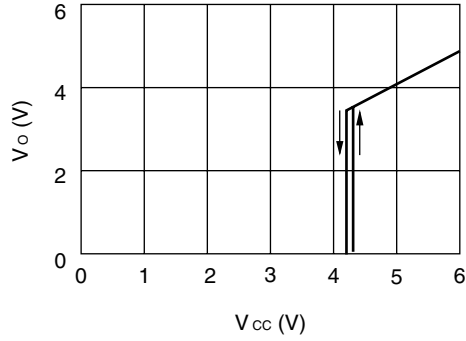


## 5. Recovery Reset Circuit

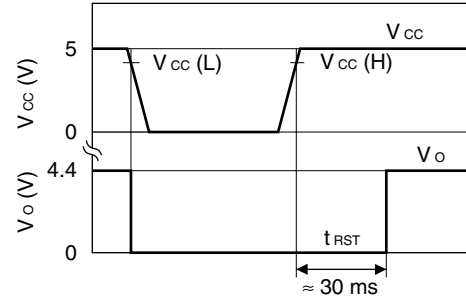


## ■ TYPICAL CHARACTERISTICS

DC Characteristics



Response Characteristics



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

$$V_{CC(L)} = \frac{R_1 + R_2 + R_3}{R_3} V_{TH}$$

$$V_{CC(H)} = V_{CC(L)} + \frac{R_1 (R_2 + R_3)}{R_3 R_4} V_{TH}$$

- 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

## ■ NOTES ON USE

- Take account of common impedance when designing the earth line on a printed wiring board.
- Take measures against static electricity.
  - For semiconductors, use antistatic or conductive containers.
  - When storing or carrying a printed circuit board after chip mounting, put it in a conductive bag or container.
  - The work table, tools and measuring instruments must be grounded.
  - The worker must put on a grounding device containing 250 kΩ to 1 MΩ resistors in series.
- Do not apply a negative voltage
  - Applying a negative voltage of -0.3 V or less to an LSI may generate a parasitic transistor, resulting in malfunction.

## ■ ORDERING INFORMATION

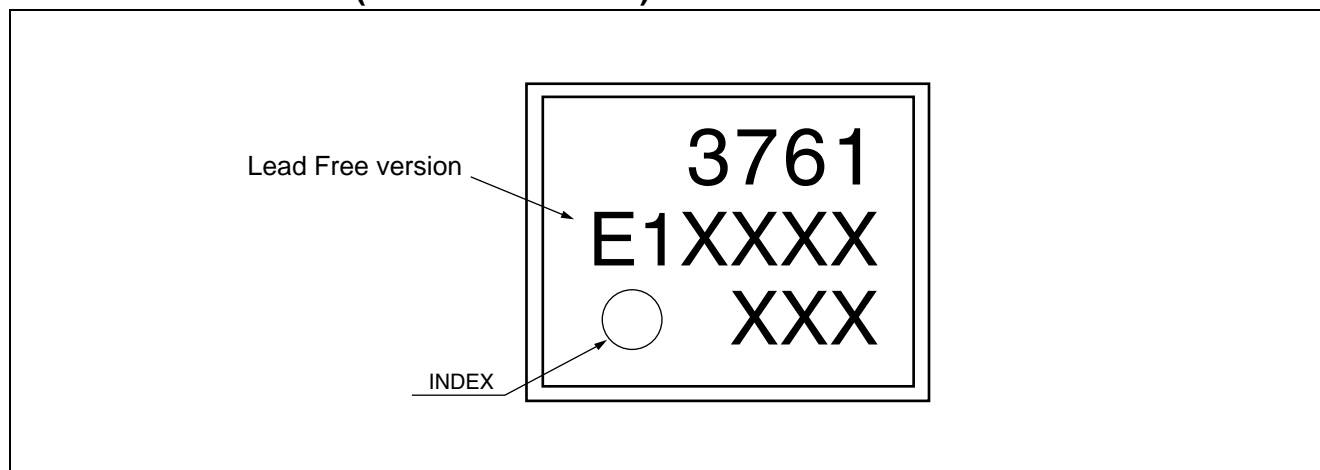
Part number	Package	Remarks
MB3761PF-□□□	8-pin plastic SOP (FPT-8P-M01)	Conventional version
MB3761PF-□□□E1	8-pin plastic SOP (FPT-8P-M01)	Lead Free version

## ■ RoHS Compliance Information of Lead (Pb) Free version

The LSI products of Fujitsu with “E1” are compliant with RoHS Directive , and has observed the standard of lead, cadmium, mercury, Hexavalent chromium, polybrominated biphenyls (PBB) , and polybrominated diphenyl ethers (PBDE) .

The product that conforms to this standard is added “E1” at the end of the part number.

## ■ MARKING FORMAT (Lead Free version)



# MB3761

## ■ LABELING SAMPLE (Lead free version)

The image shows a rectangular label with the following text and markings:

- Top line: **MB123456P - 789 - GE1**
- Second line: (3N) 1MB123456P-789-GE1 1000
- Barcode
- Third line: (3N)2 1561190005 107210
- Barcode
- Fourth line: 1,000 PCS
- Fifth line: **MB123456P - 789 - GE1**
- Barcode
- Sixth line: 2006/03/01 ASSEMBLED IN JAPAN
- Horizontal dashed line
- Seventh line: **MB123456P - 789 - GE1**
- Eighth line: 1561190005 1/1 0605 - Z01A 1000

Annotations and logos:

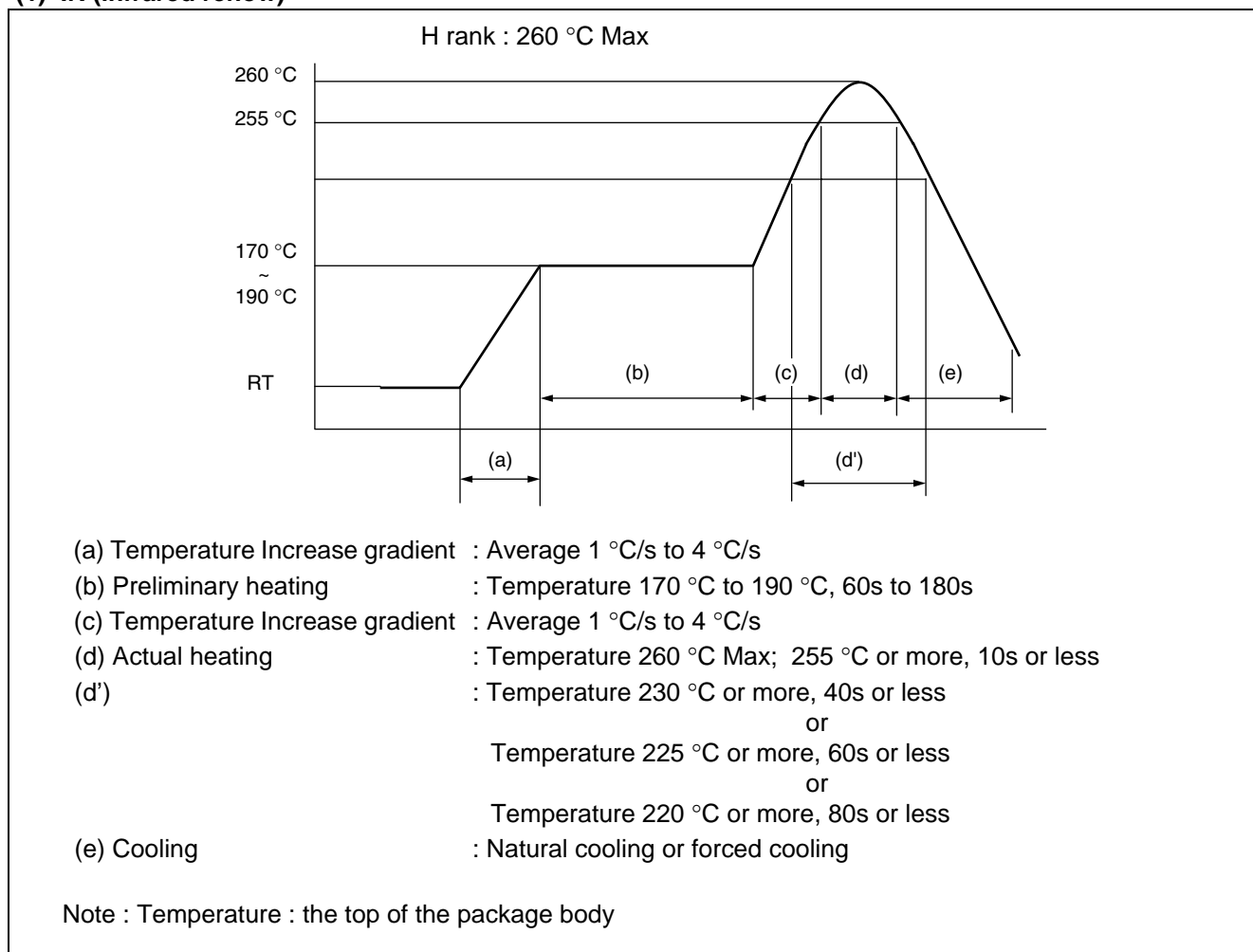
- Lead free mark**: Points to a square box containing the letter 'G'.
- JEITA logo**: Points to the 'G' box.
- JEDEC logo**: Points to a circle containing 'Pb' with a diagonal slash through it.
- QC PASS**: Text located to the right of the label.
- Lead Free version**: Points to the '1/1' in the bottom right corner of the label.

## ■ MB3761PF-□□□E1 RECOMMENDED CONDITIONS OF MOISTURE SENSITIVITY LEVEL

Item	Condition	
Mounting Method	IR (infrared reflow) , Manual soldering (partial heating method)	
Mounting times	2 times	
Storage period	Before opening	Please use it within two years after Manufacture.
	From opening to the 2nd reflow	Less than 8 days
	When the storage period after opening was exceeded	Please processes within 8 days after baking (125 °C, 24H)
Storage conditions	5 °C to 30 °C, 70%RH or less (the lowest possible humidity)	

### [Temperature Profile for FJ Standard IR Reflow]

#### (1) IR (infrared reflow)



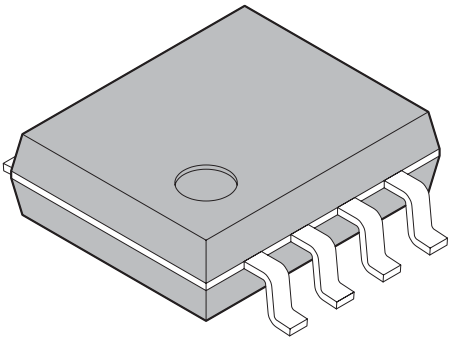
#### (2) Manual soldering (partial heating method)

Conditions : Temperature 400 °C Max

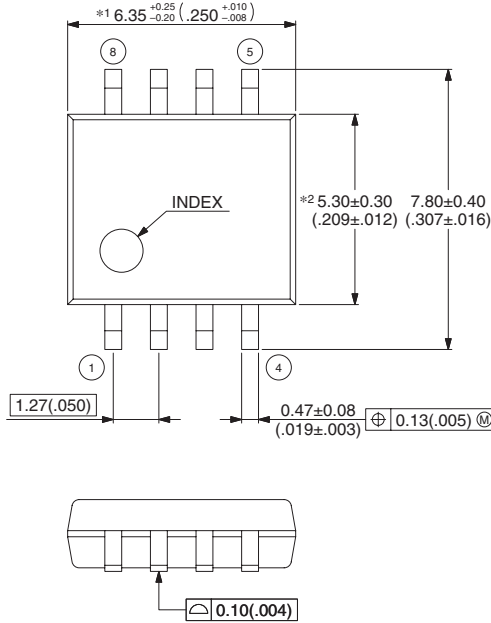
Times : 5 s max/pin

# MB3761

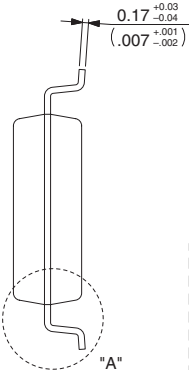
## ■ PACKAGE DIMENSION

<p style="text-align: center;">8-pin plastic SOP</p>  <p style="text-align: center;">(FPT-8P-M01)</p>	Lead pitch	1.27 mm
	Package width × package length	5.3 × 6.35 mm
	Lead shape	Gullwing
	Sealing method	Plastic mold
	Mounting height	2.25 mm MAX
	Weight	0.10 g
	Code (Reference)	P-SOP8-5.3×6.35-1.27

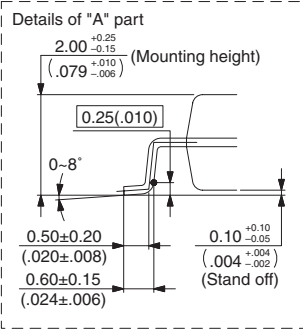
8-pin plastic SOP  
(FPT-8P-M01)



Note 1) \*1 : These dimensions include resin protrusion.  
 Note 2) \*2 : These dimensions do not include resin protrusion.  
 Note 3) Pins width and pins thickness include plating thickness.  
 Note 4) Pins width do not include tie bar cutting remainder.



Details of "A" part



Dimensions in mm (inches).  
Note: The values in parentheses are reference values.

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Any semiconductor devices have an inherent chance of failure. You must protect against injury, damage or loss from such failures by incorporating safety design measures into your facility and equipment such as redundancy, fire protection, and prevention of over-current levels and other abnormal operating conditions.

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