

# MAX707, MAX708

## μP Supervisory Circuits

The MAX707/708 are cost-effective system supervisor circuits designed to monitor Vcc in digital systems and provide a reset signal to the host processor when necessary. No external components are required.

The reset output is driven active within 20 μsec of Vcc falling through the reset voltage threshold. Reset is maintained with 200 mS of delay time after Vcc rise above the reset threshold. The MAX707/708 have a low quiescent current of 12 μA at Vcc = 3.3 V, an active-high RESET and active-low  $\overline{\text{RESET}}$  with a push-pull output. The output is guaranteed valid down to Vcc = 1.0 V. The MAX707/708 have a Manual Reset  $\overline{\text{MR}}$  input and a +1.25 V threshold detector for power-fail input PFI. These devices are available in a Micro8 and SOIC-8 package.

### Features

- Precision Supply-Voltage Monitor  
MAX707: 4.63 V Reset Threshold Voltage  
MAX708: Standard Reset Threshold Voltages (Typical):  
4.38 V, 3.08 V, 2.93 V, 2.63 V
- Reset Threshold Available from 1.6 V to 4.9 V with 100 mV Increments (Factory Option)
- 200 mS (Typ) Reset Timeout Delay
- 12 μA (Vcc = 3.3 V) Quiescent Current
- Active\_High and Active\_Low Reset Output
- Guaranteed RESET\_L and RESET Output Valid to Vcc = 1.0 V
- Voltage Monitor for Power-Fail or Low-Battery Warning
- 8 Pin SO or Micro8 Package

### Applications

- Computers
- Embedded System
- Battery Powered Equipment
- Critical μP Power Supply Monitor

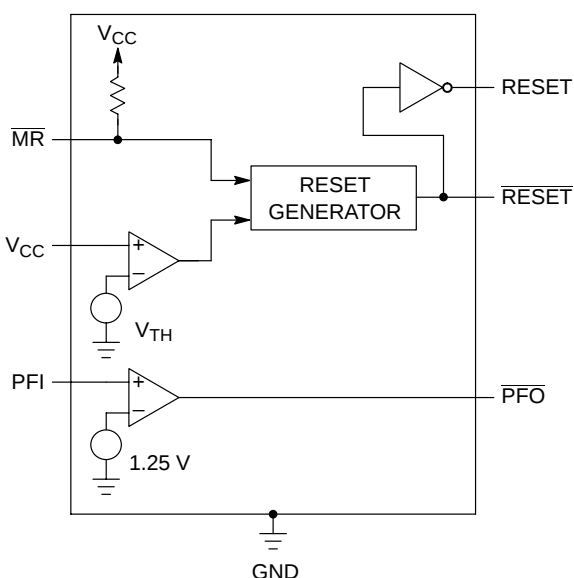


Figure 1. Representative Block Diagram



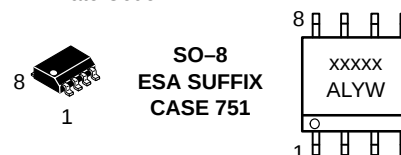
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### MARKING DIAGRAMS

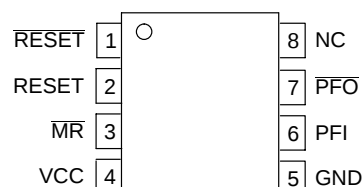


xxx = Specific Device Code (see page 9)  
R = Factory Code  
YW = Date Code



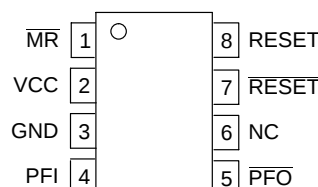
xxxxx = Specific Date Code (see page 9)  
AL = Assembly Lot Code  
YW = Date Code

### PIN CONFIGURATION



(Top View)

Micro8



(Top View)

SO-8

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 9 of this data sheet.

# MAX707, MAX708

## MAXIMUM RATINGS (Note 1)

| Rating                                               | Symbol          | Value                      | Unit |
|------------------------------------------------------|-----------------|----------------------------|------|
| Supply Voltage                                       | $V_{CC}$        | 6.0                        | V    |
| Output Voltage                                       | $V_{out}$       | -0.3 to ( $V_{CC} + 0.3$ ) | V    |
| Output Current (All Outputs)                         | $I_{out}$       | 20                         | mA   |
| Input Current ( $V_{CC}$ and GND)                    | $I_{in}$        | 20                         | mA   |
| Thermal Resistance Junction to Air<br>Micro8<br>SO-8 | $R_{\theta JA}$ | 248<br>187                 | °C/W |
| Operating Ambient Temperature                        | $T_A$           | -40 to +85                 | °C   |
| Storage Temperature Range                            | $T_{stg}$       | -40 to +125                | °C   |
| Latch-Up Performance<br>Positive<br>Negative         | $I_{LATCH-UP}$  | 300<br>280                 | mA   |

- This device series contains ESD protection and exceeds the following tests:  
Human Body Model 2000 V per MIL-STD-883, Method 3015.  
Machine Model Method 200 V.
- The maximum package power dissipation limit must not be exceeded.

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}} \quad \text{with } T_{J(max)} = 150^\circ\text{C}$$

# MAX707, MAX708

**ELECTRICAL CHARACTERISTICS** ( $V_{CC} = 1.0 \text{ V}$  to  $5.5 \text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ , unless otherwise noted. Typical values are at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.3 \text{ V}$ .)

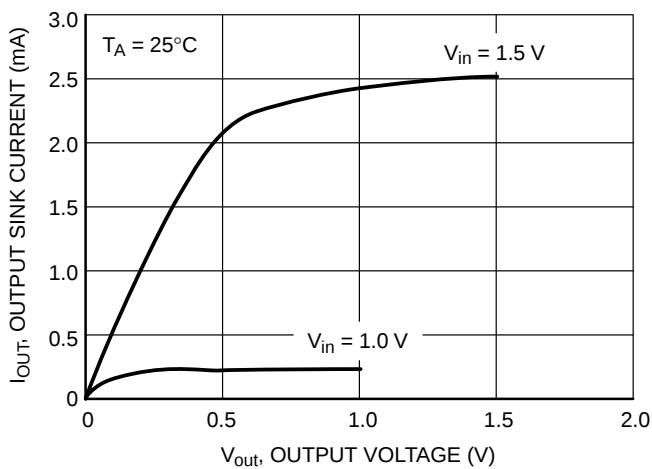
| Characteristics                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Symbol    | Min                                                                          | Typ                  | Max                                                                          | Unit             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------------------------------------------------------------------------|----------------------|------------------------------------------------------------------------------|------------------|
| Operating Voltage Range                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | $V_{CC}$  | 1.0                                                                          | –                    | 5.5                                                                          | V                |
| Supply Current<br>$V_{CC} = 3.3 \text{ V}$<br>$V_{CC} = 5.5 \text{ V}$                                                                                                                                                                                                                                                                                                                                                                                                                    | $I_{CC}$  | –<br>–                                                                       | 12<br>16             | 22<br>28                                                                     | $\mu\text{A}$    |
| Reset Threshold<br>MAX707<br>$T_A = +25^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$<br>MAX708<br>$T_A = +25^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$<br>MAX708T<br>$T_A = +25^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$<br>MAX708S<br>$T_A = +25^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$<br>MAX708R<br>$T_A = +25^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | $V_{TH}$  | 4.56<br>4.50<br>4.31<br>4.25<br>3.03<br>3.00<br>2.89<br>2.85<br>2.59<br>2.55 | 4.63<br>4.38<br>3.08 | 4.70<br>4.75<br>4.45<br>4.50<br>3.13<br>3.15<br>2.97<br>3.00<br>2.67<br>2.70 | V                |
| Reset Threshold Hysteresis                                                                                                                                                                                                                                                                                                                                                                                                                                                                | $V_{HYS}$ | –                                                                            | $0.01 V_{TH}$        | –                                                                            | mV               |
| $V_{CC}$ Falling Reset Delay ( $V_{CC} = V_{TH} + 0.2 \text{ V}$ to $V_{TH} - 0.2 \text{ V}$ )                                                                                                                                                                                                                                                                                                                                                                                            | $t_{PD}$  | –                                                                            | 20                   | –                                                                            | $\mu\text{S}$    |
| Reset Active Timeout Period                                                                                                                                                                                                                                                                                                                                                                                                                                                               | $t_{RP}$  | 140                                                                          | 200                  | 330                                                                          | mS               |
| RESET_L, RESET_H Output Low Voltage<br>$V_{CC} \geq 1.0 \text{ V}$ , $I_{OL} = 100 \mu\text{A}$<br>$V_{CC} > 2.7 \text{ V}$ , $I_{OL} = 1.2 \text{ mA}$<br>$V_{CC} > 4.5 \text{ V}$ , $I_{OL} = 3.2 \text{ mA}$                                                                                                                                                                                                                                                                           | $V_{OL}$  | –<br>–<br>–                                                                  | –<br>–<br>–          | 0.3<br>0.3<br>0.3                                                            | V                |
| RESET_L, RESET_H Output High Voltage<br>$V_{CC} \geq 1.0 \text{ V}$ , $I_{OH} = 50 \mu\text{A}$<br>$V_{CC} > 2.7 \text{ V}$ , $I_{OH} = 500 \mu\text{A}$<br>$V_{CC} > 4.5 \text{ V}$ , $I_{OH} = 800 \mu\text{A}$                                                                                                                                                                                                                                                                         | $V_{OH}$  | $0.8 V_{CC}$<br>$0.8 V_{CC}$<br>$0.8 V_{CC}$                                 | –<br>–<br>–          | –<br>–<br>–                                                                  | V                |
| MR_L Pull-up Resistance                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | $R_{MRI}$ | 50                                                                           | –                    | –                                                                            | $\text{K}\Omega$ |
| MR_L Pulse Width ( $V_{TH}(\text{max}) < V_{CC} < 5.5 \text{ V}$ )                                                                                                                                                                                                                                                                                                                                                                                                                        | $t_{MR}$  | 1.0                                                                          | –                    | –                                                                            | $\mu\text{S}$    |
| MR_L Glitch Rejection ( $V_{TH}(\text{max}) < V_{CC} < 5.5 \text{ V}$ )                                                                                                                                                                                                                                                                                                                                                                                                                   | –         | –                                                                            | 0.1                  | –                                                                            | $\mu\text{S}$    |
| MR_L High_level Input Threshold ( $V_{TH}(\text{max}) < V_{CC} < 5.5 \text{ V}$ )                                                                                                                                                                                                                                                                                                                                                                                                         | $V_{IH}$  | $0.7 V_{CC}$                                                                 | –                    | –                                                                            | V                |
| MR_L Low_level Input Threshold ( $V_{TH}(\text{max}) < V_{CC} < 5.5 \text{ V}$ )                                                                                                                                                                                                                                                                                                                                                                                                          | $V_{IL}$  | –                                                                            | –                    | $0.3 V_{CC}$                                                                 | V                |
| MR_L to RESET_L and RESET_H Output Delay<br>( $V_{TH}(\text{max}) < V_{CC} < 5.5 \text{ V}$ )                                                                                                                                                                                                                                                                                                                                                                                             | $t_{MD}$  | –                                                                            | 0.2                  | –                                                                            | $\mu\text{S}$    |
| PFI Input Threshold ( $V_{CC} = 3.3 \text{ V}$ , PFI Falling)                                                                                                                                                                                                                                                                                                                                                                                                                             | –         | 1.20                                                                         | 1.25                 | 1.3                                                                          | V                |
| PFI Input Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | –         | –250                                                                         | 0.01                 | 250                                                                          | nA               |
| PFI to PFO Delay ( $V_{CC} = 3.3 \text{ V}$ , $V_{OVERDRIVE} = 15 \text{ mV}$ )                                                                                                                                                                                                                                                                                                                                                                                                           | –         | –                                                                            | 3.0                  | –                                                                            | $\mu\text{S}$    |
| PFO_L Output Low Voltage<br>$V_{CC} = 2.7 \text{ V}$ , $I_{OL} = 1.2 \text{ mA}$<br>$V_{CC} = 4.5 \text{ V}$ , $I_{OL} = 3.2 \text{ mA}$                                                                                                                                                                                                                                                                                                                                                  | $V_{OL}$  | –<br>–                                                                       | –<br>–               | 0.3<br>0.3                                                                   | V                |
| PFO_L Output High Voltage<br>$V_{CC} = 2.7 \text{ V}$ , $I_{OH} = 500 \mu\text{A}$<br>$V_{CC} = 4.5 \text{ V}$ , $I_{OH} = 800 \mu\text{A}$                                                                                                                                                                                                                                                                                                                                               | $V_{OH}$  | $0.8 V_{CC}$<br>$0.8 V_{CC}$                                                 | –<br>–               | –<br>–                                                                       | V                |

## MAX707, MAX708

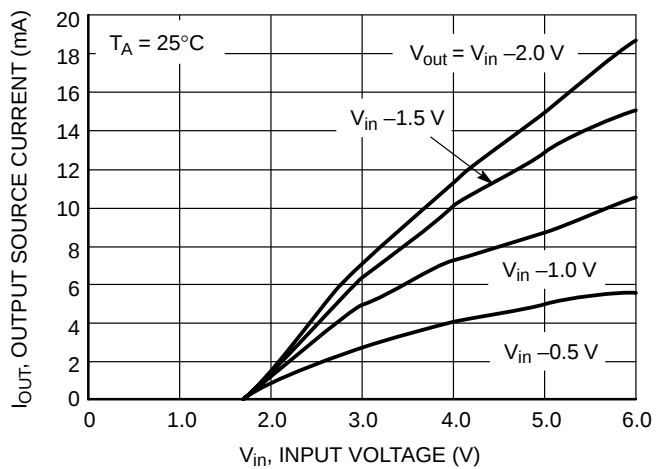
### PIN DESCRIPTION (Pin No. with parentheses is for Micro8 package.)

| Pin No. | Symbol                    | Description                                                                                                                                                                                                                               |
|---------|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 (3)   | $\overline{\text{MR}}$    | Manual Reset Input. $\overline{\text{MR}}$ can be driven from TTL/CMOS logic or from a manual Reset switch. This input, when floating, is internally pulled up to $V_{\text{CC}}$ with 50 K $\Omega$ resistor.                            |
| 2 (4)   | $V_{\text{CC}}$           | Supply Voltage: C = 100nF is recommended as a bypass capacitor between $V_{\text{CC}}$ and GND.                                                                                                                                           |
| 3 (5)   | GND                       | Ground Reference                                                                                                                                                                                                                          |
| 4 (6)   | PFI                       | Power Fail Voltage Monitor Input. When PFI is less than 1.25 V, $\overline{\text{PFO}}$ goes low. Connect PFI to GND or $V_{\text{CC}}$ when not used.                                                                                    |
| 5 (7)   | $\overline{\text{PFO}}$   | Power Fail Monitor Output. When PFI is less than 1.25 V, it goes low and sinks current. Otherwise, it remains high.                                                                                                                       |
| 6 (8)   | NC                        | Non-connective Pin                                                                                                                                                                                                                        |
| 7 (1)   | $\overline{\text{RESET}}$ | Active Low $\overline{\text{RESET}}$ can be triggered by $V_{\text{CC}}$ below the threshold level or by a low signal on $\overline{\text{MR}}$ . It remains low for 200 ms (typ.) after $V_{\text{CC}}$ rises above the reset threshold. |
| 8 (2)   | RESET                     | Active high RESET output the inverse of $\overline{\text{RESET}}$ one.                                                                                                                                                                    |

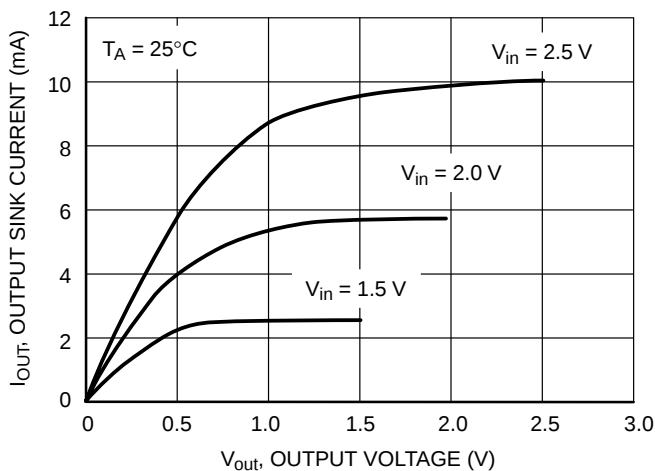
# MAX707, MAX708



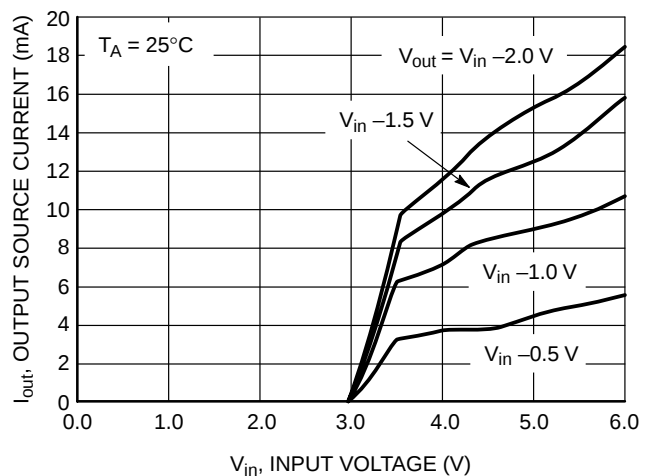
**Figure 2. MAX707/708 Series 1.60 V Reset Output Sink Current vs. Output Voltage**



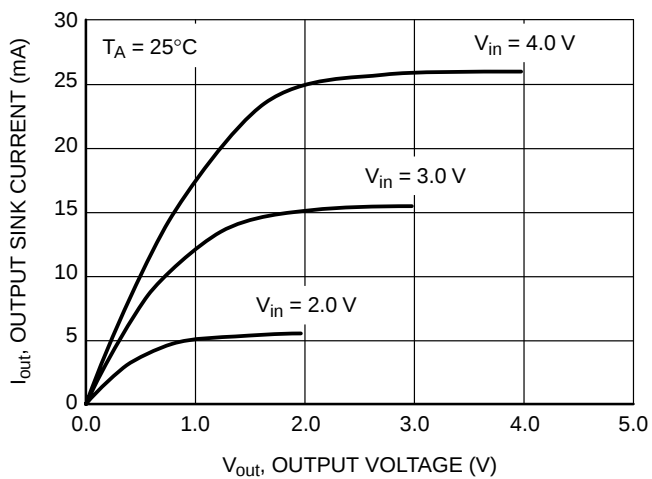
**Figure 3. MAX707/708 Series 1.60 V Reset Output Source Current vs. Input Voltage**



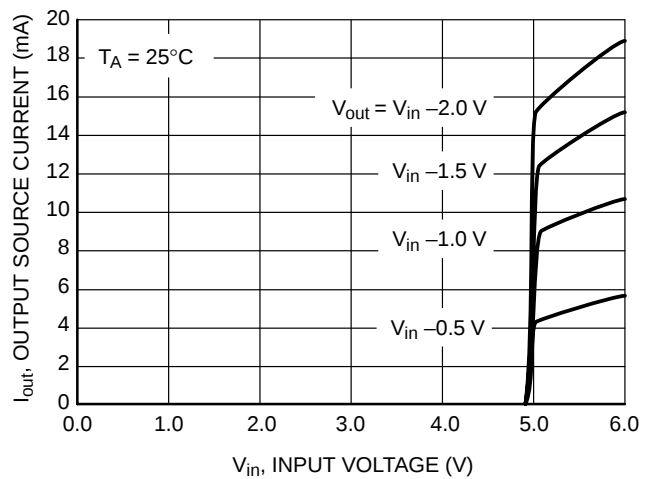
**Figure 4. MAX707/708 Series 2.93 V Reset Output Sink Current vs. Output Voltage**



**Figure 5. MAX707/708 Series 2.93 V Reset Output Source Current vs. Input Voltage**

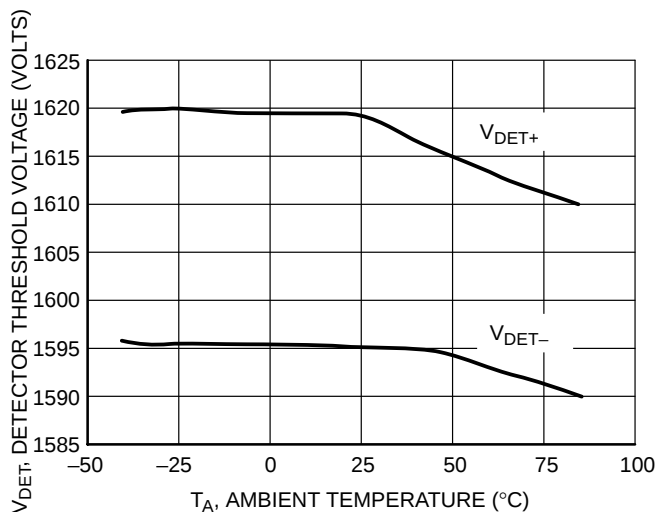


**Figure 6. MAX707/708 Series 4.90 V Reset Output Sink Current vs. Output Voltage**

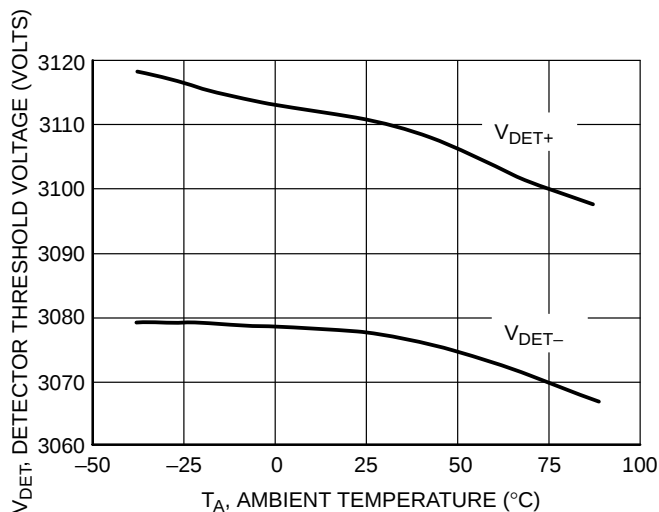


**Figure 7. MAX707/708 Series 4.90 V Reset Output Source Current vs. Input Voltage**

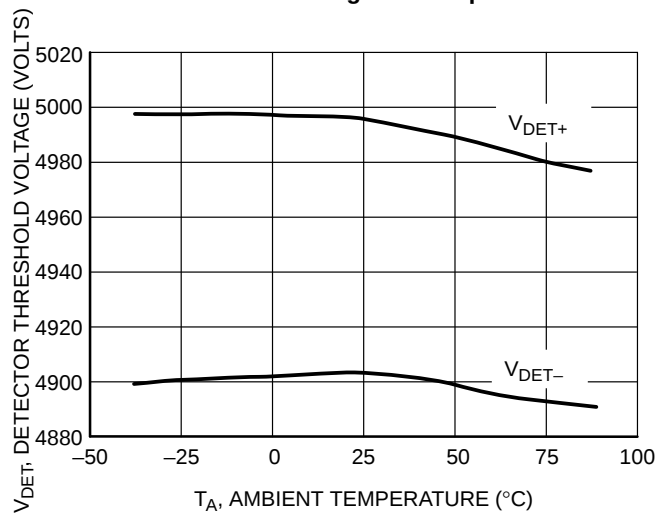
# MAX707, MAX708



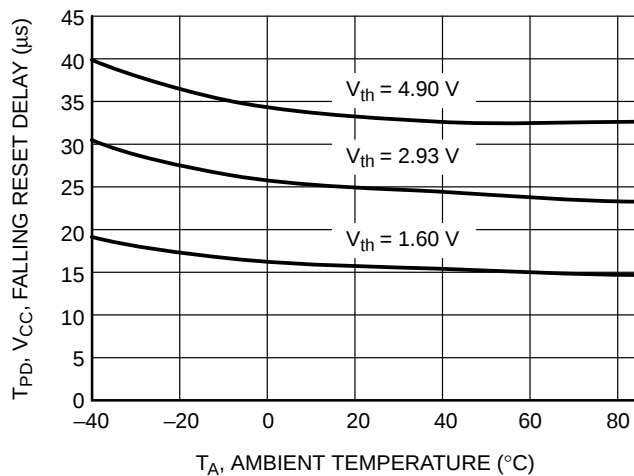
**Figure 8. MAX707/708 Series 1.60 V Detector Threshold Voltage vs. Temperature**



**Figure 9. MAX707/708 Series 2.93 V Detector Threshold Voltage vs. Temperature**



**Figure 10. MAX707/708 Series 4.90 V Detector Threshold Voltage vs. Temperature**



**Figure 11. MAX707/708 Series V<sub>CC</sub> Falling Reset Delay vs. Temperature**

# APPLICATIONS INFORMATION

## Microprocessor Reset

To generate a processor reset, the manual Reset input allows different reset sources. A pushbutton switch can be

one of these. It is effectively debounced by the 1.0  $\mu\text{s}$  minimum reset pulse width. As  $\overline{\text{MR}}$  is TTL/CMOS logic compatible, it can be driven by an external logic line.

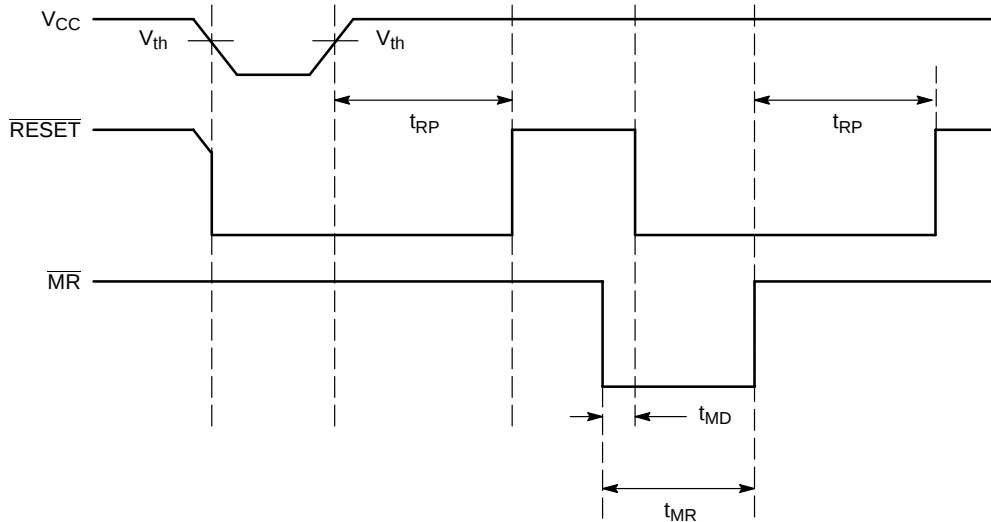


Figure 12.  $\overline{\text{RESET}}$  and  $\overline{\text{MR}}$  Timing

## VCC Transient Rejection

The MAX707/708 provides accurate  $V_{CC}$  monitoring and reset timing during power-up, power-down, and brownout/sag conditions, and rejects negative glitches on the power supply line. Figure 13 shows the maximum transient duration vs. maximum negative excursion

(overdrive) for glitch rejection. For a given overdrive, the point of the curve is the maximum width of the glitch allowed before the device generates a reset signal. Transient immunity can be improved by adding a capacitor (100 nF for example) in close proximity to the  $V_{CC}$  pin of the MAX707/708.

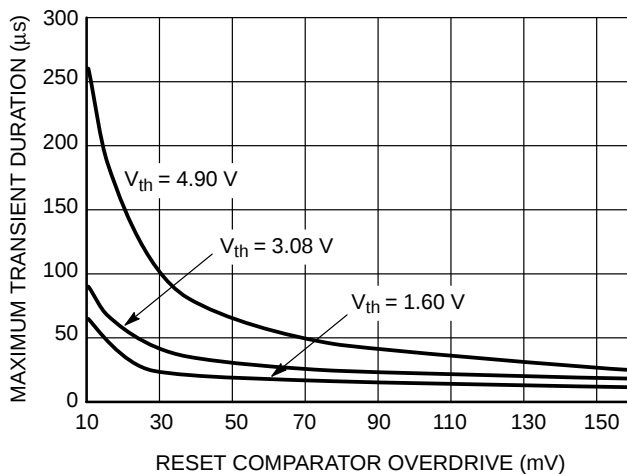
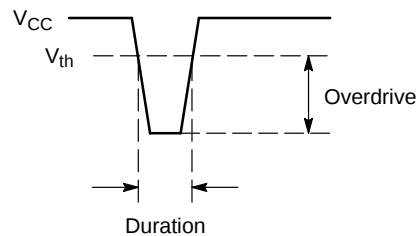


Figure 13. Maximum Transient Duration vs. Overdrive for Glitch Rejection at 25°C



### RESET Signal Integrity During Power-Down

The MAX707/708  $\overline{\text{RESET}}$  output is valid until  $V_{CC}$  falls below 1.0 V. Then, the output becomes an open circuit and no longer sinks current. This means CMOS logic inputs of the  $\mu\text{P}$  will be floating at an undetermined voltage. Most digital systems are completely shutdown well above this voltage. However, in the case  $\overline{\text{RESET}}$  must be maintained valid to  $V_{CC} = 0$  V, a pull down resistor must be connected from  $\overline{\text{RESET}}$  to ground to discharge stray capacitances and hold the output low (Figure 14). This resistor value, though not critical, should be chosen large enough not to load  $\overline{\text{RESET}}$  and small enough to pull it to ground.  $R = 100 \text{ k}\Omega$  will be suitable for most applications.

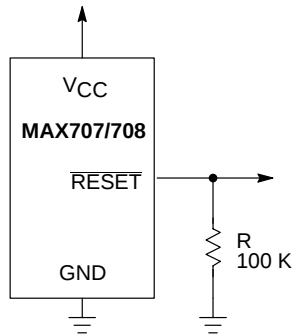


Figure 14. Ensuring  $\overline{\text{RESET}}$  Valid to  $V_{CC} = 0$  V

### Interfacing with $\mu\text{Ps}$ with Bidirectional I/O Pins

Some  $\mu\text{Ps}$  (such as Motorola 68HC11) have bidirectional reset pins. If, for example, the  $\overline{\text{RESET}}$  output is driven high and the  $\mu\text{P}$  wants to put it low, indeterminate logic level may result. This can be avoided by adding a  $4.7 \text{ k}\Omega$  resistor in series with the output of the MAX707/708 (Figure 15). If there are other components in the system that require a reset signal, they should be buffered so as not to load the reset line.

If the other components are required to follow the reset I/O of the  $\mu\text{P}$ , the buffer should be connected as shown with the solid line.

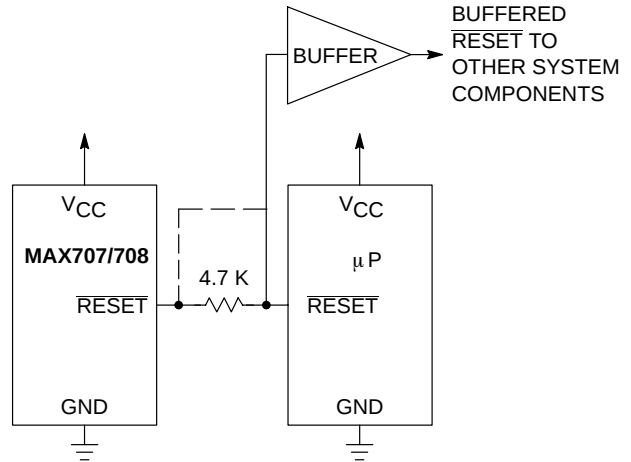
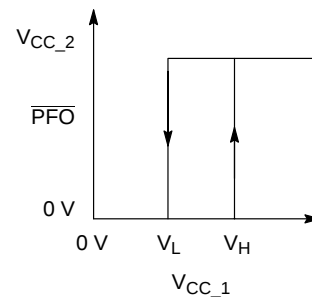
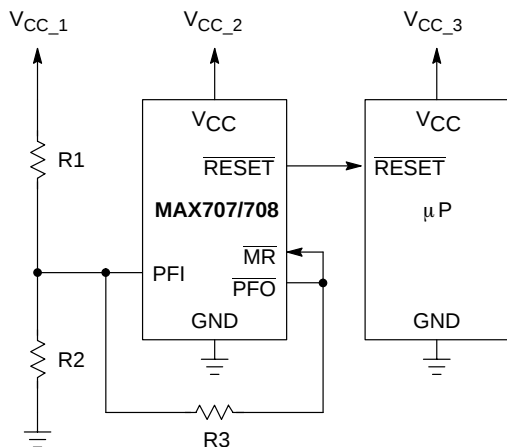


Figure 15. Interfacing to Bidirectional Reset I/O

### Monitoring Additional Supply Levels

When connecting a voltage divider to PFI and adjusting it properly, you can monitor a voltage different than the unregulated DC one. As shown in Figure 16, to increase noise immunity, hysteresis may be added to the power-fail comparator just by a resistor between  $\overline{\text{PFO}}$  and PFI. Not to unbalance the potential divider network,  $R_3$  should be 10 times the sum of the two resistors  $R_1$  and  $R_2$ . If required, a capacitor between PFI and GND will reduce the sensitivity of the circuit to high-frequency noise on the line being monitored. The  $\overline{\text{PFO}}$  output may be connected to  $\overline{\text{MR}}$  input to generate a low level on the  $\overline{\text{RESET}}$  when  $V_{CC\_1}$  drops out of tolerance. Thus a  $\overline{\text{RESET}}$  is generated when one of the two voltages is below its threshold level.



$$V_L = 1.25 + R_1 \times \left( \frac{1.25}{R_2} + \frac{1.25 - V_{CC\_2}}{R_3} \right)$$

$$V_H = 1.25 \times \left( 1 + R_1 \times \left( \frac{R_2 + R_3}{R_2 \times R_3} \right) \right)$$

$$V_{HYS} = V_H - V_L = \frac{R_1 \times V_{CC\_2}}{R_3}$$

Figure 16. Monitoring Additional Supply Levels

# MAX707, MAX708

## ORDERING INFORMATION

| Device                | Package | Marking      | Shipping         |
|-----------------------|---------|--------------|------------------|
| MAX707ESA-T           | SO-8    | S707         | 2500 Tape & Reel |
| MAX708ESA-T           | SO-8    | S708         | 2500 Tape & Reel |
| MAX708xESA-T (Note 3) | SO-8    | S708x        | 2500 Tape & Reel |
| MAX707CUA-T           | Micro8  | SAC          | 4000 Tape & Reel |
| MAX708CUA-T           | Micro8  | SAD          | 4000 Tape & Reel |
| MAX708xCUA-T (Note 3) | Micro8  | SAy (Note 4) | 4000 Tape & Reel |

3. The "x" denotes a suffix for  $V_{CC}$  threshold – see Table 1.

4. The "y" denotes a suffix for  $V_{CC}$  threshold – see Table 2.

**Table 1. Suffix "x"**

| Suffix | Reset Vcc Threshold (V) |
|--------|-------------------------|
| T      | 3.08                    |
| S      | 2.93                    |
| R      | 2.63                    |

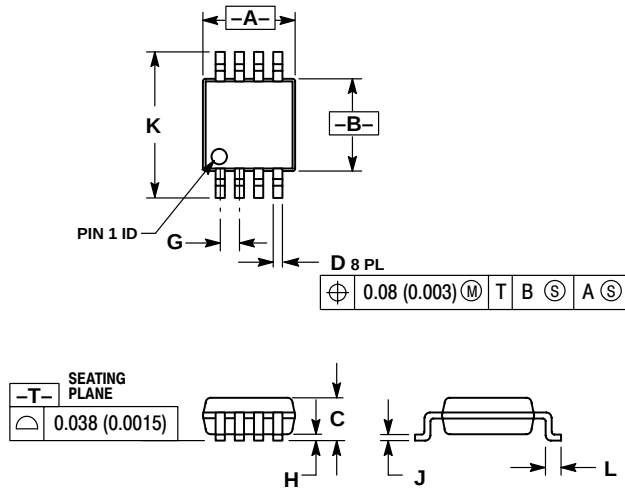
**Table 2. Suffix "y"**

| Suffix | Reset Vcc Threshold (V) |
|--------|-------------------------|
| E      | 3.08                    |
| F      | 2.93                    |
| G      | 2.63                    |

# MAX707, MAX708

## PACKAGE DIMENSIONS

Micro8  
CASE 846A-02  
ISSUE E



### NOTES:

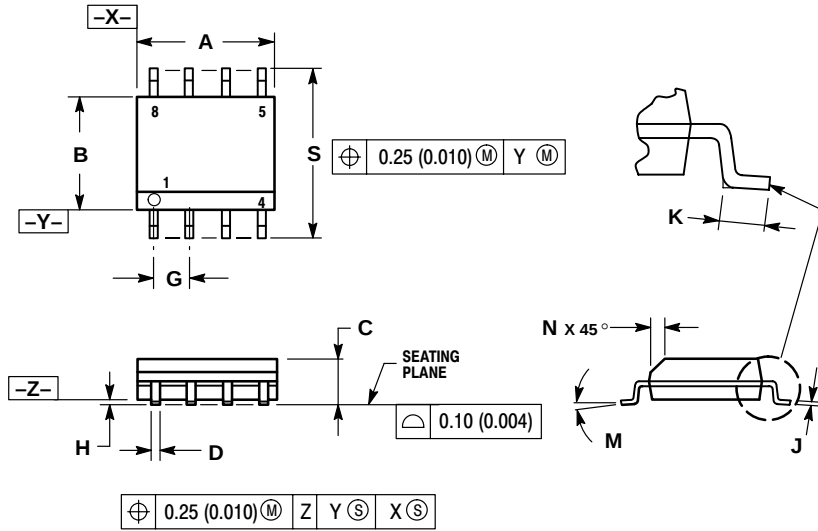
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 2.90        | 3.10 | 0.114     | 0.122 |
| B   | 2.90        | 3.10 | 0.114     | 0.122 |
| C   | ---         | 1.10 | ---       | 0.043 |
| D   | 0.25        | 0.40 | 0.010     | 0.016 |
| G   | 0.65 BSC    |      | 0.026 BSC |       |
| H   | 0.05        | 0.15 | 0.002     | 0.006 |
| J   | 0.13        | 0.23 | 0.005     | 0.009 |
| K   | 4.75        | 5.05 | 0.187     | 0.199 |
| L   | 0.40        | 0.70 | 0.016     | 0.028 |

# MAX707, MAX708

## PACKAGE DIMENSIONS

SO-8  
CASE 751-07  
ISSUE W



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 4.80        | 5.00 | 0.189     | 0.197 |
| B   | 3.80        | 4.00 | 0.150     | 0.157 |
| C   | 1.35        | 1.75 | 0.053     | 0.069 |
| D   | 0.33        | 0.51 | 0.013     | 0.020 |
| G   | 1.27 BSC    |      | 0.050 BSC |       |
| H   | 0.10        | 0.25 | 0.004     | 0.010 |
| J   | 0.19        | 0.25 | 0.007     | 0.010 |
| K   | 0.40        | 1.27 | 0.016     | 0.050 |
| M   | 0°          | 8°   | 0°        | 8°    |
| N   | 0.25        | 0.50 | 0.010     | 0.020 |
| S   | 5.80        | 6.20 | 0.228     | 0.244 |

## MAX707, MAX708

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