*MAXIM*

# +3V Voltage Monitoring, Low-Cost µP Supervisory Circuits

## General Description

The MAX706P/R/S/T, MAX706AP/AR/AS/AT, and MAX708R/S/T microprocessor (µP) supervisory circuits reduce the complexity and number of components required to monitor +3V power-supply levels in +3V to +5V µP systems. These devices significantly improve system reliability and accuracy compared to separate ICs or discrete components.

The MAX706P/R/S/T and MAX706AP/AR/AS/AT supervisory circuits provide the following four functions:

1) A reset output during power-up, power-down, and brownout conditions.

2) An independent watchdog output that goes low if the watchdog input has not been toggled within 1.6s.

3) A 1.25V threshold detector for power-fail warning, low-battery detection, or for monitoring a power supply other than the main supply.

4) An active-low, manual-reset input.

The only difference between the MAX706R/AR, MAX706S/AS, and MAX706T/AT is the reset-threshold voltage levels, which are 2.63V, 2.93V, and 3.08V, respectively. All have active-low reset output signals. The MAX706P/AP are identical to the MAX706R/AR, except the reset output signal is active-high. The watchdog timer function for the MAX706AP/AR/AS/AT disables when the WDI input is left open or connected to a high-impedance state of a low-leakage tri-state output.

The MAX708R/S/T provide the same functions as the MAX706R/S/T and MAX706AR/AS/AT except they do not have a watchdog timer. Instead, they provide both $\overline{\text{RESET}}$ and RESET outputs. As with the MAX706, devices with R, S, and T suffixes have reset thresholds of 2.63V, 2.93V, and 3.08V, respectively.

These devices are available in 8-pin SO, DIP, and µMAX® packages and are fully specified over the operating temperature range.

## Applications

Battery-Powered Equipment

Portable Instruments

Computers

Controllers

Intelligent Instruments

Critical µP Power Monitoring

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## Features

♦ **µMAX Package, Small 8-Pin SO**

♦ **Precision Supply-Voltage Monitors**
  2.63V (MAX706P/R, MAX706AP/AR, and MAX708R)
  2.93V (MAX706S, MAX706AS, and MAX708S)
  3.08V (MAX706T, MAX706AT, and MAX708T)

♦ **200ms Reset Time Delay**

♦ **Debounced TTL/CMOS-Compatible Manual Reset Input**

♦ **100µA Quiescent Current**

♦ **WDI Disable Feature (MAX706AP/AR/AS/AT)**

♦ **Watchdog Timer: 1.6s Timeout**

♦ **Reset Output Signal:**
  Active-High Only (MAX706P, MAX706AP)
  Active-Low Only (MAX706R/S/T, MAX706AR/AS/AT)
  Active-High and Active-Low (MAX708R/S/T)

♦ **Voltage Monitor for Power-Fail or Low-Battery Warning**

♦ **8-Pin Surface-Mount Package**

♦ **Guaranteed $\overline{\text{RESET}}$ Assertion to $V_{CC}$ = 1V**
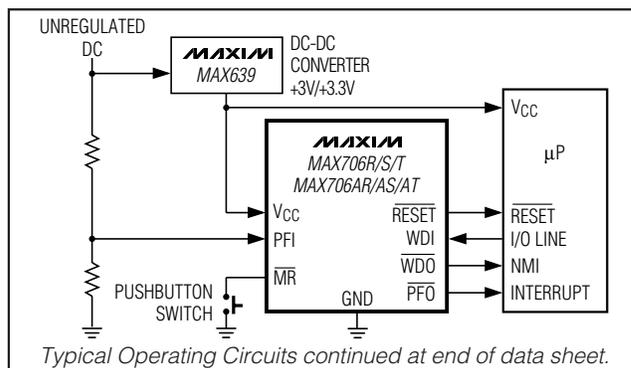
## Ordering Information

| PART† | TEMP RANGE | PIN-PACKAGE | PKG CODE |
|---|---|---|---|
| **MAX706P**CPA | 0°C to +70°C | 8 PDIP | P8-1 |
| MAX706PCSA | 0°C to +70°C | 8 SO | S8-2 |
| MAX706PCUA | 0°C to +70°C | 8 µMAX | U8-1 |
| MAX706PEPA | -40°C to +85°C | 8 PDIP | P8-1 |

†*SO, µMAX, and PDIP packages are available in lead-free.*

*Ordering Information continued at end of data sheet.*
*Pin Configurations appear at end of data sheet.*

## Typical Operating Circuits



*Typical Operating Circuits continued at end of data sheet.*

*For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at*
*1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.*

# +3V Voltage Monitoring, Low-Cost µP Supervisory Circuits

## ABSOLUTE MAXIMUM RATINGS

Terminal Voltage (with respect to GND)
  $V_{CC}$.........................................................................-0.3V to +6V
  All Other Inputs (Note 1).........................-0.3V to ($V_{CC}$ + 0.3V)
Input Current
  $V_{CC}$ ..................................................................20mA
  GND ..................................................................20mA
Output Current (all outputs) ...............................................20mA
Continuous Power Dissipation ($T_A$ = +70°C)
  8-Pin CERDIP (derate 8mW/°C above +70°C).............640mW
  8-Pin PDIP (derate 9.1mW/°C above +70°C)............727.3mW

  8-Pin SO (derate 5.9mW/°C above +70°C)................470.6mW
  8-Pin µMAX (derate 4.5mW/ºC above +70°C).............362mW
Operating Temperature Range
  MAX70_C .........................................................0°C to +70°C
  MAX70_E ........................................................-40°C to +85°C
  MAX70_M .....................................................-55°C to +125°C
Junction Temperature....................................................+150°C
Storage Temperature Range ............................-65°C to +150°C
Lead Temperature (soldering, 10s) ................................+300°C

**Note 1:** The input-voltage limits on PFI, WDI, and $\overline{MR}$ can be exceeded if the input current is less than 10mA.

*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

## ELECTRICAL CHARACTERISTICS

(MAX70_P/R, MAX706AP/AR: $V_{CC}$ = 2.7V to 5.5V; MAX70_S, MAX706AS: $V_{CC}$ = 3.0V to 5.5V; MAX70_T, MAX706AT: $V_{CC}$ = 3.15V to 5.5V; $T_J = T_A = T_{MIN}$ to $T_{MAX}$, unless otherwise noted. Typical values are at $T_J = T_A$ = +25°C.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Supply Voltage Range | $V_{CC}$ | | MAX70_C | 1.0 | | 5.5 | V |
| | | | MAX70_E/M | 1.2 | | 5.5 | |
| Supply Current | $I_{SUPPLY}$ | $V_{CC}$ < 3.6V | MAX706_C | | 90 | 200 | µA |
| | | | MAX706_E/M | | 90 | 300 | |
| | | | MAX708_C | | 50 | 200 | |
| | | | MAX708_E/M | | 50 | 300 | |
| | | $V_{CC}$ < 5.5V | MAX706_C | | 135 | 350 | |
| | | | MAX706_E/M | | 135 | 500 | |
| | | | MAX708_C | | 65 | 350 | |
| | | | MAX708_E/M | | 65 | 500 | |
| Reset Threshold (Note 3) ($V_{CC}$ Falling) | $V_{RST}$ | MAX70_P/R, MAX706AP/AR | | 2.55 | 2.63 | 2.70 | V |
| | | MAX70_S, MAX706AS | | 2.85 | 2.93 | 3.00 | |
| | | MAX70_T, MAX706AT | | 3.00 | 3.08 | 3.15 | |
| Reset Threshold Hysteresis (Note 3) | $V_{HYS}$ | | | | 20 | | mV |
| Reset Pulse Width (Note 3) | $t_{RST}$ | MAX70_P/R, MAX706AP/AR $V_{CC}$ = 3.0V | | 140 | 200 | 280 | ms |
| | | MAX70_S, MAX706AS, $V_{CC}$ = 3.3V | | 140 | 200 | 280 | |
| | | $V_{CC}$ = 5V | | | 200 | | |
| **RESET OUTPUT** | | | | | | | |
| Output-Voltage High (MAX70_R/S/T) (MAX706AR/AS/AT) | $V_{OH}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | $I_{SOURCE}$ = 500µA | 0.8 x $V_{CC}$ | | | V |
| | $V_{OL}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | $I_{SINK}$ = 1.2mA | | | 0.3 | |
| | $V_{OH}$ | 4.5V < $V_{CC}$ < 5.5V | $I_{RSOURCE}$ = 800µA | $V_{CC}$ - 1.5 | | | |
| | $V_{OL}$ | 4.5V < $V_{CC}$ < 5.5V | $I_{SINK}$ = 3.2mA | | | 0.4 | |
| | $V_{OL}$ | MAX70_C $V_{CC}$ = 1.0V, $I_{SINK}$ = 50µA | | | | 0.3 | |
| | | MAX70_E/M: $V_{CC}$ = 1.2V, $I_{SINK}$ = 100µA | | | | 0.3 | |

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## ELECTRICAL CHARACTERISTICS (continued)

(MAX70_P/R, MAX706AP/AR: $V_{CC}$ = 2.7V to 5.5V; MAX70_S, MAX706AS: $V_{CC}$ = 3.0V to 5.5V; MAX70_T, MAX706AT: $V_{CC}$ = 3.15V to 5.5V; $T_J$ = $T_A$ = $T_{MIN}$ to $T_{MAX}$, unless otherwise noted. Typical values are at $T_J$ = $T_A$ = +25°C.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Output-Voltage High (MAX706P) (MAX706AP) | $V_{OH}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | $I_{SOURCE}$ = 215μA | $V_{CC}$ – 0.6 | | | V |
| | $V_{OL}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | $I_{SINK}$ = 1.2mA | | | 0.3 | |
| | $V_{OH}$ | 4.5 < $V_{CC}$ < 5.5V | $I_{SOURCE}$ = 800μA | $V_{CC}$ - 1.5 | | | |
| | $V_{OL}$ | 4.5V < $V_{CC}$ < 5.5V | $I_{SINK}$ = 3.2mA | | | 0.4 | |
| Output-Voltage High (MAX708_) | $V_{OH}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | $I_{SOURCE}$ = 500μA | 0.8 x $V_{CC}$ | | | V |
| | $V_{OL}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | $I_{SINK}$ = 500μA | | | 0.3 | |
| | $V_{OH}$ | 4.5V < $V_{CC}$ < 5.5V | $I_{SOURCE}$ = 800μA | $V_{CC}$ - 1.5 | | | |
| | $V_{OL}$ | 4.5V < $V_{CC}$ < 5.5V | $I_{SINK}$ = 1.2mA | | | 0.4 | |
| **WATCHDOG INPUT** | | | | | | | |
| Watchdog Timeout Period | $t_{WD}$ | MAX706P/R, MAX706AP/AR, $V_{CC}$ = 3.0V | | 1.00 | 1.6 | 2.25 | s |
| | | MAX706S/T, MAX706AS/AT, $V_{CC}$ = 3.3V | | 1.00 | 1.6 | 2.25 | |
| WDI Pulse Width (MAX706_, MAX706A_) | $t_{WP}$ | $V_{IL}$ = 0.4V | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | 100 | | | ns |
| | | $V_{IH}$ = 0.8V x $V_{CC}$ | 4.5V < $V_{CC}$ < 5.5V | 50 | | | |
| Watchdog Input Threshold (MAX706_, MAX706A_) | $V_{IL}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | | | | 0.6 | V |
| | $V_{IH}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | | 0.7 x $V_{CC}$ | | | |
| | $V_{IL}$ | $V_{CC}$ = 5.0V | | | | 0.8 | |
| | $V_{IH}$ | $V_{CC}$ = 5.0V | | 3.5 | | | |
| WDI Input Current | | WDI = 0V or $V_{CC}$ | MAX706_ | -1.0 | +0.02 | +1.0 | μA |
| | | | MAX706A_ | -5 | | +5 | |

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**MAX706P/R/S/T, MAX706AP/AR/AS/AT, MAX708R/S/T**

## ELECTRICAL CHARACTERISTICS (continued)

(MAX70_P/R, MAX706AP/AR: $V_{CC}$ = 2.7V to 5.5V; MAX70_S, MAX706AS: $V_{CC}$ = 3.0V to 5.5V; MAX70_T, MAX706AT: $V_{CC}$ = 3.15V to 5.5V; $T_J$ = $T_A$ = $T_{MIN}$ to $T_{MAX}$, unless otherwise noted. Typical values are at $T_J$ = $T_A$ = +25°C.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **WATCHDOG OUTPUT** | | | | | | | |
| $\overline{WDO}$ Output Voltage (MAX706_, MAX706A_) | $V_{OH}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | $I_{SOURCE}$ = 500µA | 0.8 x $V_{CC}$ | | | V |
| | $V_{OL}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | $I_{SINK}$ = 500µA | | | 0.3 | |
| | $V_{OH}$ | 4.5V < $V_{CC}$ < 5.5V | $I_{SOURCE}$ = 800µA | $V_{CC}$ - 1.5 | | | |
| | $V_{OL}$ | 4.5V < $V_{CC}$ < 5.5V | $I_{SINK}$ = 1.2mA | | | 0.4 | |
| **MANUAL RESET INPUT** | | | | | | | |
| $\overline{MR}$ Pullup Current | | $\overline{MR}$ = 0 | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | 25 | 70 | 250 | µA |
| | | | 4.5V < $V_{CC}$ < 5.5V | 100 | 250 | 600 | |
| $\overline{MR}$ Pulse Width | $t_{MR}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | | 500 | | | ns |
| | | 4.5V < $V_{CC}$ < 5.5V | | 150 | | | |
| $\overline{MR}$ Input Threshold | $V_{IL}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | | | | 0.6 | V |
| | $V_{IH}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | | 0.7 x $V_{CC}$ | | | |
| | $V_{IL}$ | 4.5V < $V_{CC}$ < 5.5V | | | | 0.8 | |
| | $V_{IH}$ | 4.5V < $V_{CC}$ < 5.5V | | 2.0 | | | |
| $\overline{MR}$ to Reset Output Delay | $t_{MD}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | | | | 750 | ns |
| | | 4.5V < $V_{CC}$ < 5.5V | | | | 250 | |
| **POWER-FAILURE COMPARATOR** | | | | | | | |
| PFI Input Threshold | | (MAX70_P/R, MAX706AP/AR) PFI falling $V_{CC}$ = 3.0V | | 1.2 | 1.25 | 1.3 | V |
| | | (MAX70_S/T, MAX706AS/AT) PFI falling, $V_{CC}$ = 3.3V | | 1.2 | 1.25 | 1.3 | |
| PFI Input Current | | | | -25 | +0.01 | +25 | nA |
| $\overline{PFO}$ Output Voltage | $V_{OH}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | $I_{SOURCE}$ = 500µA | 0.8 x $V_{CC}$ | | | V |
| | $V_{OL}$ | $V_{RST(MAX)}$ < $V_{CC}$ < 3.6V | $I_{SINK}$ = 1.2mA | | | 0.3 | |
| | $V_{OH}$ | 4.5V < $V_{CC}$ < 5.5V | $I_{SOURCE}$ = 800µA | $V_{CC}$ - 1.5 | | | |
| | $V_{OL}$ | 4.5V < $V_{CC}$ < 5.5V | $I_{SINK}$ = 3.2mA | | | 0.4 | |

**Note 2:** All devices 100% production tested at $T_A$ = +85°C. Limits over temperature are guaranteed by design.
**Note 3:** Applies to both $\overline{RESET}$ in the MAX70_R/S/T and MAX706AR/AS/AT, and RESET in the MAX706P/MAX706AP.

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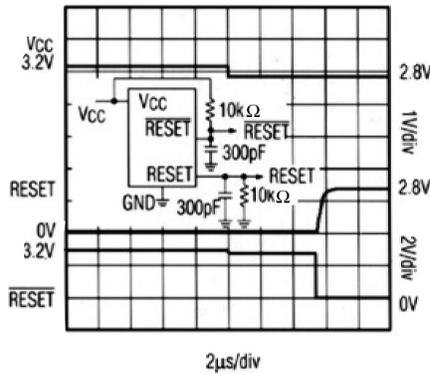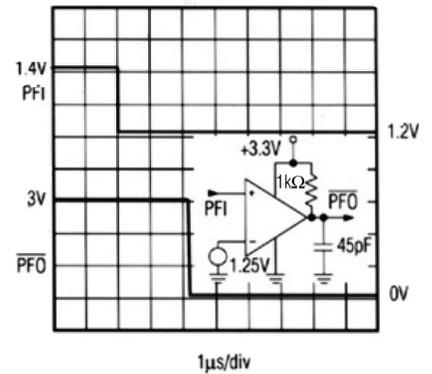
## _Typical Operating Characteristics_

($T_A$ = +25°C, unless otherwise noted.)

**RESET, RESET OUTPUT VOLTAGES vs. SUPPLY VOLTAGE (RESET OUTPUTS AND RESET THRESHOLDS SHOWN FOR MAX708T, $T_A$ = +25°C)**
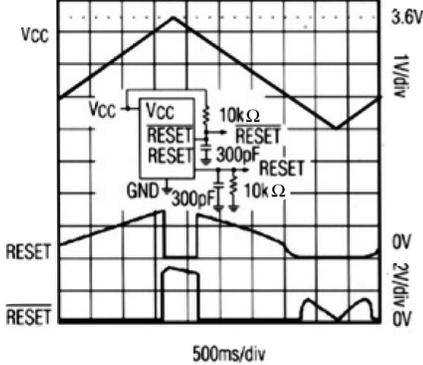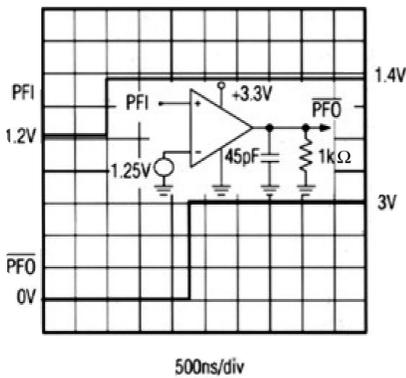
**RESET, RESET RESPONSE TIMES**
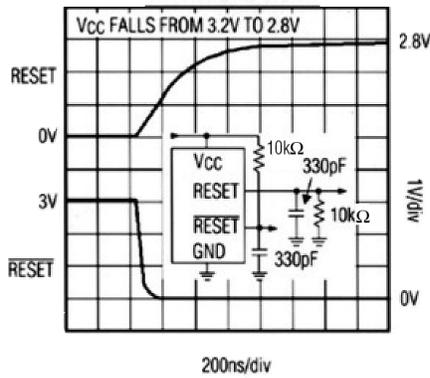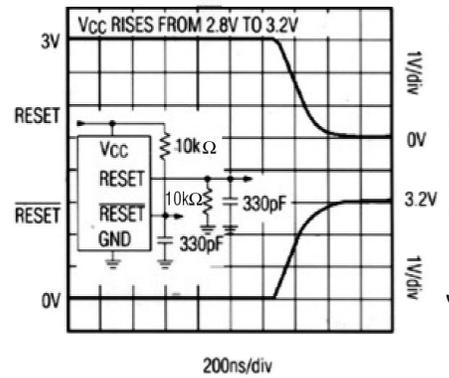
**POWER-FAIL COMPARATOR ASSERTION RESPONSE TIME**

**POWER-FAIL COMPARATOR DEASSERTION RESPONSE TIME**

**RESET, RESET RISE AND FALL TIMES (RESET ASSERTED)**

**RESET, RESET RISE AND FALL TIMES (RESET DEASSERTED)**

## Pin Description

| MAX706P MAX706AP | | MAX706R/S/T, MAX706AR/AS/AT | | MAX708R/S/T | | NAME | FUNCTION |
|---|---|---|---|---|---|---|---|
| SO/DIP | µMAX | SO/DIP | µMAX | SO/DIP | µMAX | | |
| 1 | 3 | 1 | 3 | 1 | 3 | $\overline{MR}$ | Active-Low, Manual-Reset Input. Pull $\overline{MR}$ below 0.6V to trigger a reset pulse. $\overline{MR}$ is TTL/CMOS compatible when $V_{CC}$ = 5V and can be shorted to GND with a switch. $\overline{MR}$ is internally connected to a 70µA source current. Connect to $V_{CC}$ or leave unconnected. |
| 2 | 4 | 2 | 4 | 2 | 4 | $V_{CC}$ | Supply Voltage Input |
| 3 | 5 | 3 | 5 | 3 | 5 | GND | Ground |
| 4 | 6 | 4 | 6 | 4 | 6 | PFI | Adjustable Power-Fail Comparator Input. Connect PFI to a resistive divider to set the desired PFI threshold. When PFI is less than 1.25V, $\overline{PFO}$ goes low and sinks current; otherwise, $\overline{PFO}$ remains high. Connect PFI to GND if not used. |
| 5 | 7 | 5 | 7 | 5 | 7 | $\overline{PFO}$ | Active-Low, Power-Fail Comparator Output. $\overline{PFO}$ asserts when PFI is below the internal 1.25V threshold. $\overline{PFO}$ deasserts when PFI is above the internal 1.25V threshold. Leave $\overline{PFO}$ unconnected if not used. |
| 6 | 8 | 6 | 8 | — | — | WDI | Watchdog Input. A falling or rising transition must occur at WDI within 1.6s to prevent $\overline{WDO}$ from asserting (see Figure 4). The internal watchdog timer is reset to zero when reset is asserted or when transition occurs at WDI. The watchdog function for the MAX706P/R/S/T can not be disabled. The watchdog timer for the MAX706AP/AR/AS/AT disables when WDI input is left open or connected to a tri-state output in its high-impedance state with a leakage current of less than 600nA. |
| 7 | 1 | — | — | 8 | 2 | RESET | Active-High Reset Output. RESET remains high when $V_{CC}$ is below the reset threshold or $\overline{MR}$ is held low. It remains low for 200ms after the reset conditions end (Figure 3). |
| 8 | 2 | 8 | 2 | — | — | $\overline{WDO}$ | Active-Low Watchdog Output. $\overline{WDO}$ goes low when a transition does not occur at WDI within 1.6s and remains low until a transition occurs at WDI (indicating the watchdog interrupt has been serviced). $\overline{WDO}$ also goes low when $V_{CC}$ falls below the reset threshold; however, unlike the reset output signal, $\overline{WDO}$ goes high as soon as $V_{CC}$ rises above the reset threshold. |
| — | — | 7 | 1 | 7 | 1 | $\overline{RESET}$ | Active-Low Reset Output. $\overline{RESET}$ remains low when $V_{CC}$ is below the reset threshold or $\overline{MR}$ is held low. It remains low for 200ms after the reset conditions end (Figure 3). |
| — | — | — | — | 6 | 8 | N.C. | No Connection. Not internally connected. |

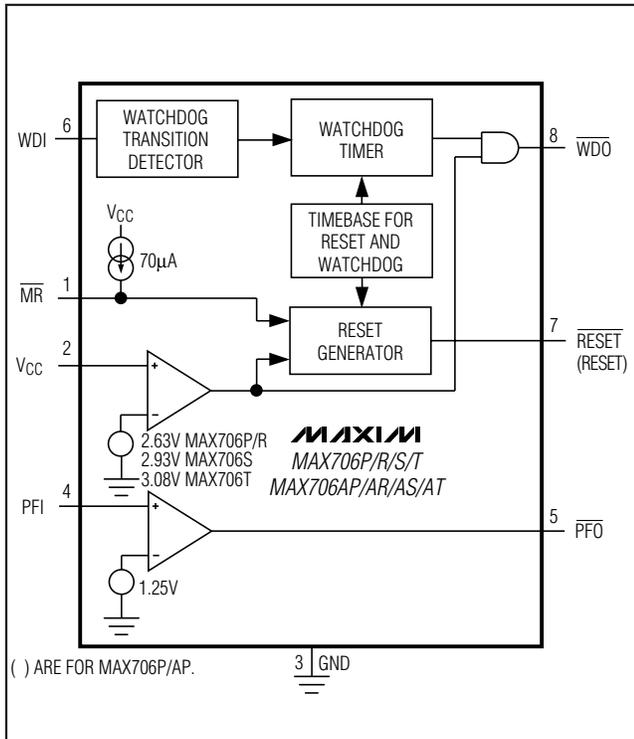**MAXIM**

Figure 1. MAX706_ Functional Diagram



Figure 2. MAX708_ Functional Diagram

### RESET and $\overline{RESET}$ Outputs

A microprocessor's (µP's) reset input starts in a known state. When the µP is in an unknown state, it should be held in reset. The MAX706P/R/S/T and the MAX706AP/AR/AS/AT assert reset when $V_{CC}$ is low, preventing code execution errors during power-up, power-down, or brownout conditions.

On power-up once $V_{CC}$ reaches 1V, $\overline{RESET}$ is guaranteed to be logic-low and RESET is guaranteed to be logic-high. As $V_{CC}$ rises, $\overline{RESET}$ and RESET remain asserted. Once $V_{CC}$ exceeds the reset threshold, the internal timer causes $\overline{RESET}$ and RESET to be deasserted after a time equal to the reset pulse width, which is typically 200ms (Figure 3).

If a power-fail or brownout condition occurs (i.e., $V_{CC}$ drops below the reset threshold), $\overline{RESET}$ and RESET are asserted. As long as $V_{CC}$ remains below the reset threshold, the internal timer is continually reset, causing the $\overline{RESET}$ and RESET outputs to remain asserted. Thus, a brownout condition that interrupts a previously initiated reset pulse causes an additional 200ms delay from the time the latest interruption occurred. On power-down once $V_{CC}$ drops below the reset threshold,
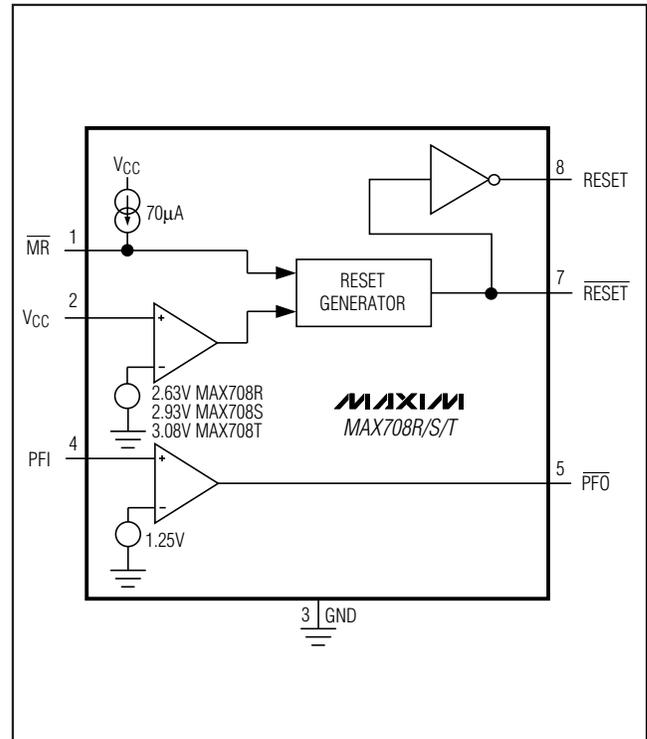
$\overline{RESET}$ and RESET are guaranteed to be asserted for $V_{CC} \geq 1V$.

The MAX706P/MAX706AP provide a RESET signal, and the MAX706R/S/T and MAX706AR/AS/AT provide a $\overline{RESET}$ signal. The MAX708R/S/T provide both RESET and $\overline{RESET}$.

### Watchdog Timer

The MAX706P/R/S/T and the MAX706AP/AR/AS/AT watchdog circuit monitor the µP's activity. If the µP does not toggle the watchdog input (WDI) within 1.6s, the watchdog output ($\overline{WDO}$) goes low (Figure 4). If the reset signal is asserted, the watchdog timer will be reset to zero and disabled. As soon as reset is released, the timer starts counting. WDI can detect pulses as narrow as 100ns with a 2.7V supply and 50ns with a 4.5V supply. The watchdog timer for the MAX706P/R/S/T cannot be disabled. The watchdog timer for the MAX706AP/AR/AS/AT operates similarly to the MAX706P/R/S/T. However, the watchdog timer for the MAX706AP/AR/AS/AT disables when the WDI input is left open or connected to a tri-state output in its high-impedance state and with a leakage current of less than 600nA. The watchdog timer can be disabled any-time, provided $\overline{WDO}$ is not asserted.
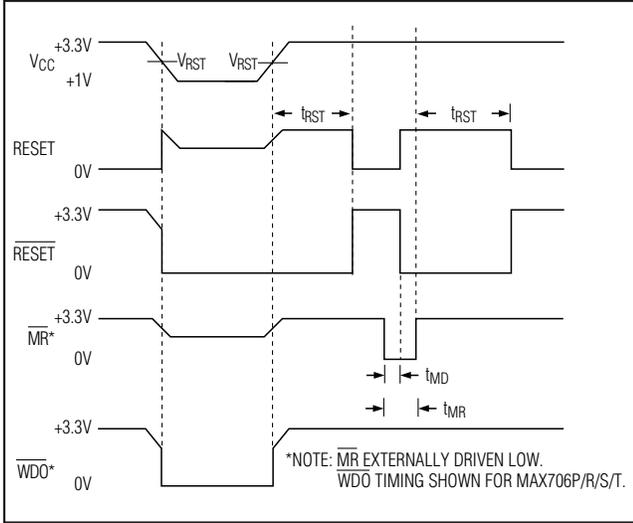
Figure 3. RESET, $\overline{RESET}$, $\overline{MR}$, and $\overline{WDO}$ Timing
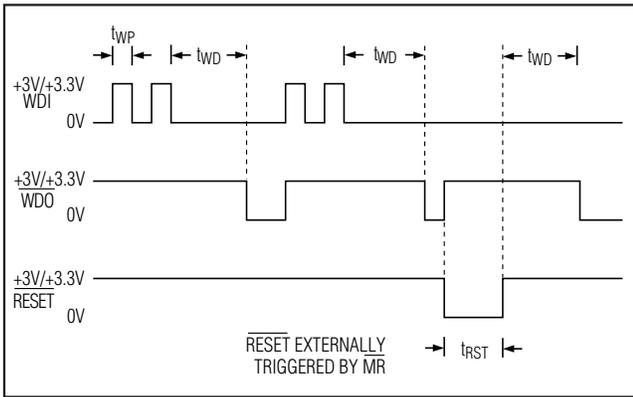


Figure 4. MAX706AP/AR/AS/AT Watchdog Timing



Figure 5. Monitoring Both +3V/+3.3V and +12V
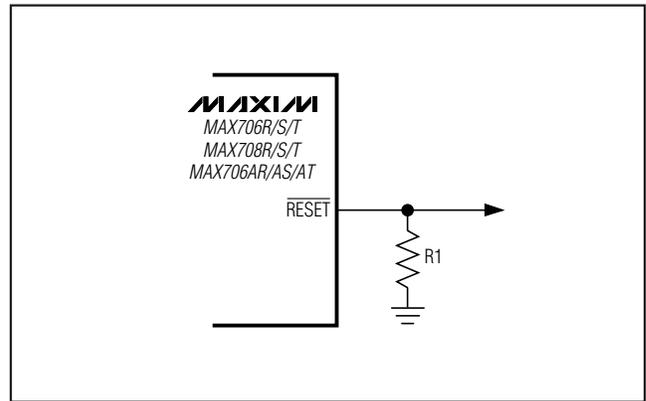


Figure 6. $\overline{RESET}$ Valid to GND Circuit

$\overline{WDO}$ can be connected to the nonmaskable interrupt (NMI) input of a µP. When $V_{CC}$ drops below the reset threshold, $\overline{WDO}$ immediately goes low, even if the watchdog timer has not timed out (Figure 3). Normally, this would trigger an NMI, but since reset is asserted simultaneously, the NMI is overridden. The $\overline{WDO}$ should not be connected to $\overline{RESET}$ directly. Instead, connect $\overline{WDO}$ to $\overline{MR}$ to generate a reset pulse when it times out.

### Manual Reset

The manual reset ($\overline{MR}$) input allows $\overline{RESET}$ and RESET to be activated by a pushbutton switch. The switch is effectively debounced by the 140ms minimum reset pulse width. $\overline{MR}$ can be driven by an external logic line since it is TTL/CMOS compatible. The minimum $\overline{MR}$ input pulse width is 500ns when $V_{CC}$ = +3V and 150ns when $V_{CC}$ = +5V. Leave $\overline{MR}$ unconnected or connect to $V_{CC}$ when not used.

### Power-Fail Comparator

The power-fail comparator can be used for various purposes because its output and noninverting input are not internally connected. The inverting input is internally connected to a 1.25V reference. The power-fail comparator has 10mV of hysteresis, which prevents repeated triggering of the power-fail output ($\overline{PFO}$).

To build an early-warning power-failure circuit, use the power-fail comparator input (PFI) to monitor the unregulated DC supply voltage (see the *Typical Operating Circuits*). Connect the PFI to a resistive-divider network such that the voltage at PFI falls below 1.25V just before the regulator drops out. Use $\overline{PFO}$ to interrupt the µP so it can prepare for an orderly power-down.

Regulated and unregulated voltages can be monitored by simply adjusting the PFI resistive-divider network values to the appropriate ratio. In addition, the reset signal can be asserted at voltages other that $V_{CC}$ reset threshold, as shown in Figure 5. Connect $\overline{PFO}$ to $\overline{MR}$ to initiate a reset pulse when the 12V supply drops below a user-specified threshold (11V in this example) or when $V_{CC}$ falls below the reset threshold.

### Operation with +3V and +5V Supplies

The MAX706P/R/S/T, the MAX706AP/AR/AS/AT, and the MAX708R/S/T provide voltage monitoring at the reset threshold (2.63V to 3.08V) when powered from either +3V or +5V. These devices are ideal in portable-instrument applications where power can be supplied from either a +3V battery or an AC-DC wall adapter that generates +5V (a +5V supply allows a µP or a microcontroller to run faster than a +3V supply). With a +3V supply, these ICs consume less power, but output drive capability is reduced, the $\overline{MR}$ to $\overline{RESET}$ delay time increases, and the $\overline{MR}$ minimum pulse width increases. The *Electrical Characteristics* table provides specifications for operation with both +3V and +5V supplies.

### Ensuring a Valid $\overline{RESET}$ Output Down to $V_{CC} = 0V$

When $V_{CC}$ falls below 1V, the MAX706R/S/T, MAX706AR/AS/AT, and MAX708R/S/T $\overline{RESET}$ output no longer sinks current; it becomes an open circuit. High-impedance, CMOS logic inputs can drift to undetermined voltages if left as open circuit. If a pulldown resistor is added to the $\overline{RESET}$ pin , as shown in Figure 6, any stray charge or leakage current will flow to ground, holding $\overline{RESET}$ low. Resistor value R is not critical, but it should not load $\overline{RESET}$ and should be small enough to pull $\overline{RESET}$ and the input it is driving to ground. 100kΩ is suggested for R1.

### _____Applications Information

### Adding Hysteresis to the Power-Fail Comparator

Hysteresis adds a noise margin to the power-fail comparator and prevents repeated triggering of the $\overline{PFO}$ when $V_{IN}$ is near the power-fail comparator trip point. Figure 7 shows how to add hysteresis to the power-fail comparator. Select the ratio of R1 and R2 such that PFI



$$V_{TRIP} = 1.25\left(\frac{(R1 + R2)}{R2}\right)$$

$$V_H = 1.25\left(1 + \left(\frac{R3 + R2}{R2 \times R3}\right)R1\right) \quad V_L = 1.25 + R1\left(\frac{1.25}{R2} - \frac{V_{CC} - 1.25}{R3}\right)$$
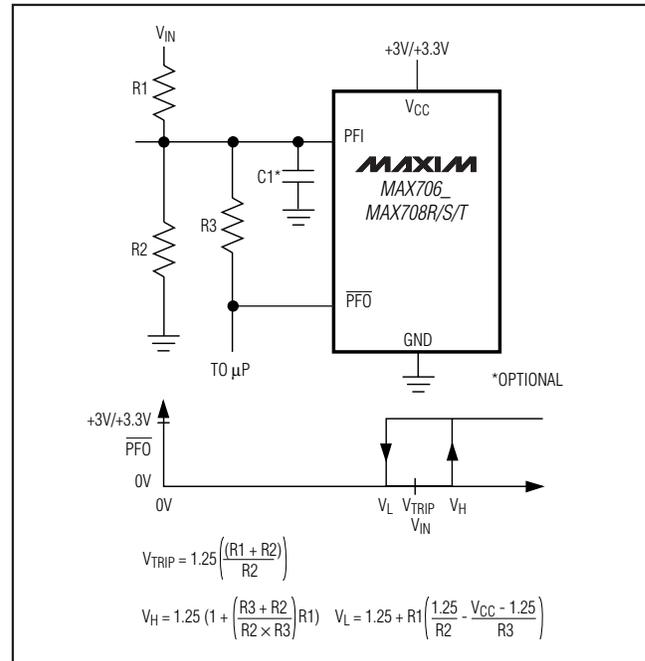
Figure 7. Adding Hysteresis to the Power-Fail Comparator



$$\frac{V_{CC} - 1.25}{R1} = \frac{1.25 - V_{TRIP}}{R2}$$

**NOTE:** $V_{TRIP}$ IS NEGATIVE.
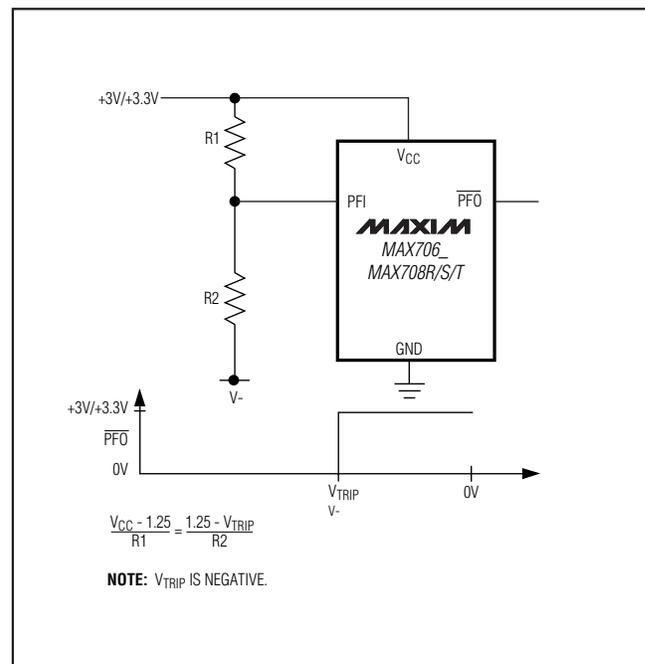
Figure 8. Monitoring a Negative Voltage

# +3V Voltage Monitoring, Low-Cost µP Supervisory Circuits

sees 1.25V when $V_{IN}$ falls to the desired trip point ($V_{TRIP}$). Resistor R3 adds hysteresis. R3 will typically be an order of magnitude greater than R1 and R2. The current through R1 and R2 should be at least 1µA to ensure that the 25nA (max) PFI input current does not shift the trip point significantly. R3 should be larger than 10kΩ to prevent it from loading down the $\overline{PFO}$ pin. Capacitor C1 adds noise rejection.

### Monitoring a Negative Voltage
The power-fail comparator can be used to monitor a negative supply voltage using the circuit of Figure 8. When the negative supply is valid, $\overline{PFO}$ is low. When the negative supply voltage drops, $\overline{PFO}$ goes high. This circuit's accuracy is affected by the PFI threshold tolerance, the $V_{CC}$ voltage, and resistors R1 and R2.

### Bypassing $V_{CC}$
For noisy systems, bypass $V_{CC}$ with a 0.1µF capacitor to GND.

## Ordering Information (continued)

| PART† | TEMP RANGE | PIN-PACKAGE | PKG CODE |
|---|---|---|---|
| MAX706PEUA | -40°C to +85°C | 8 µMAX | U8-1 |
| MAX706PMJA | -55°C to +125°C | 8 CERDIP* | J8-2 |
| **MAX706R**CPA | 0°C to +70°C | 8 Plastic Dip | P8-1 |
| MAX706RCSA | 0°C to +70°C | 8 SO | S8-2 |
| MAX706RCUA | 0°C to +70°C | 8 µMAX | U8-1 |
| MAX706REPA | -40°C to +85°C | 8 Plastic Dip | P8-1 |
| MAX706RESA | -40°C to +85°C | 8 SO | S8-2 |
| MAX706REUA | -40°C to +85°C | 8 µMAX | U8-1 |
| MAX706RMJA | -55°C to +125°C | 8 CERDIP* | J8-2 |
| **MAX706S**CPA | 0°C to +70°C | 8 Plastic Dip | P8-1 |
| MAX706SCSA | 0°C to +70°C | 8 SO | S8-2 |
| MAX706SCUA | 0°C to +70°C | 8 µMAX | U8-1 |
| MAX706SEPA | -40°C to +85°C | 8 Plastic Dip | P8-1 |
| MAX706SESA | -40°C to +85°C | 8 SO | S8-2 |
| MAX706SEUA | -40°C to +85°C | 8 µMAX | U8-1 |
| MAX706SMJA | -55°C to +125°C | 8 CERDIP* | J8-2 |
| **MAX706T**CPA | 0°C to +70°C | 8 Plastic Dip | P8-1 |
| MAX706TCSA | 0°C to +70°C | 8 SO | S8-2 |
| MAX706TCUA | 0°C to +70°C | 8 µMAX | U8-1 |
| MAX706TEPA | -40°C to +85°C | 8 Plastic Dip | P8-1 |
| MAX706TESA | -40°C to +85°C | 8 SO | S8-2 |
| MAX706TEUA | -40°C to +85°C | 8 µMAX | U8-1 |
| MAX706TMJA | -55°C to +125°C | 8 CERDIP* | J8-2 |
| **MAX706AP**EPA | -40°C to +85°C | 8 Plastic Dip | P8-1 |
| MAX706APESA | -40°C to +85°C | 8 SO | S8-2 |
| MAX706APEUA | -40°C to +85°C | 8 µMAX | U8-1 |
| **MAX706AR**EPA | -40°C to +85°C | 8 Plastic Dip | P8-1 |
| MAX706ARESA | -40°C to +85°C | 8 SO | S8-2 |
| MAX706AREUA | -40°C to +85°C | 8µMAX | U8-1 |
| **MAX706AS**EPA | -40°C to +85°C | 8 Plastic Dip | P8-1 |

| PART† | TEMP RANGE | PIN-PACKAGE | PKG CODE |
|---|---|---|---|
| MAX706ASESA | -40°C to +85°C | 8 SO | S8-2 |
| MAX706ASEUA | -40°C to +85°C | 8 µMAX | U8-1 |
| **MAX706AT**EPA | -40°C to +85°C | 8 Plastic Dip | P8-1 |
| MAX706ATESA | -40°C to +85°C | 8 SO | S8-2 |
| MAX706ATEUA | -40°C to +85°C | 8 µMAX | U8-1 |
| **MAX708R**CPA | 0°C to +70°C | 8 Plastic Dip | P8-1 |
| MAX708RCSA | 0°C to +70°C | 8 SO | S8-2 |
| MAX708RCUA | 0°C to +70°C | 8 µMAX | U8-1 |
| MAX708REPA | -40°C to +85°C | 8 Plastic Dip | P8-1 |
| MAX708RESA | -40°C to +85°C | 8 SO | S8-2 |
| MAX708REUA | -40°C to +85°C | 8 µMAX | U8-1 |
| MAX708RMJA | -55°C to +125°C | 8 CERDIP* | J8-2 |
| **MAX708S**CPA | 0°C to +70°C | 8 Plastic Dip | P8-1 |
| MAX708SCSA | 0°C to +70°C | 8 SO | S8-2 |
| MAX708SCUA | 0°C to +70°C | 8 µMAX | U8-1 |
| MAX708SEPA | -40°C to +85°C | 8 Plastic Dip | P8-1 |
| MAX708SESA | -40°C to +85°C | 8 SO | S8-2 |
| MAX708SEUA | -40°C to +85°C | 8 µMAX | U8-1 |
| MAX708SMJA | -55°C to +125°C | 8 CERDIP* | J8-2 |
| **MAX708T**CPA | 0°C to +70°C | 8 Plastic Dip | P8-1 |
| MAX708TCSA | 0°C to +70°C | 8 SO | S8-2 |
| MAX708TCUA | 0°C to +70°C | 8 µMAX | U8-1 |
| MAX708TEPA | -40°C to +85°C | 8 Plastic Dip | P8-1 |
| MAX708TESA | -40°C to +85°C | 8 SO | S8-2 |
| MAX708TEUA | -40°C to +85°C | 8 µMAX | U8-1 |
| MAX708TMJA | -55°C to +125°C | 8 CERDIP* | J8-2 |

†SO, µMAX, and PDIP packages are available in lead-free.
*Contact factory for availability and processing to MIL-STD-883.

## Chip Information

PROCESS: CMOS

**MAXIM**

## Pin Configurations

## Typical Operating Circuits
*(continued)*
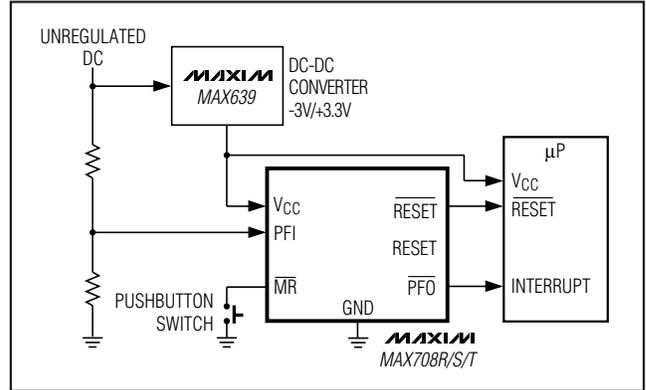
TOP VIEW



DIP/SO

MAX706P
MAX706AP

| | | | | |
|---|---|---|---|---|
| $\overline{MR}$ | 1 | | 8 | $\overline{WDO}$ |
| V$_{CC}$ | 2 | | 7 | RESET |
| GND | 3 | | 6 | WDI |
| PFI | 4 | | 5 | $\overline{PFO}$ |

DIP/SO

MAX706R/S/T
MAX706AR/AS/AT

| | | | | |
|---|---|---|---|---|
| $\overline{MR}$ | 1 | | 8 | $\overline{WDO}$ |
| V$_{CC}$ | 2 | | 7 | $\overline{RESET}$ |
| GND | 3 | | 6 | WDI |
| PFI | 4 | | 5 | $\overline{PFO}$ |

DIP/SO

MAX708R/S/T

| | | | | |
|---|---|---|---|---|
| $\overline{MR}$ | 1 | | 8 | RESET |
| V$_{CC}$ | 2 | | 7 | $\overline{RESET}$ |
| GND | 3 | | 6 | N.C. |
| PFI | 4 | | 5 | $\overline{PFO}$ |

µMAX

MAX706P/R/S/T
MAX706AP/AR/
AS/AT

| | | | | |
|---|---|---|---|---|
| (RESET) $\overline{RESET}$ | 1 | | 8 | WDI |
| $\overline{WDO}$ | 2 | | 7 | $\overline{PFO}$ |
| $\overline{MR}$ | 3 | | 6 | PFI |
| V$_{CC}$ | 4 | | 5 | GND |

µMAX

MAX708R/S/T

| | | | | |
|---|---|---|---|---|
| $\overline{RESET}$ | 1 | | 8 | N.C. |
| RESET | 2 | | 7 | $\overline{PFO}$ |
| $\overline{MR}$ | 3 | | 6 | PFI |
| V$_{CC}$ | 4 | | 5 | GND |

µMAX

( ) ARE FOR MAX706P/AP ONLY.

## Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to **www.maxim-ic.com/packages**.)



|   | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
|   | MIN | MAX | MIN | MAX |
| A | --- | 0.200 | --- | 5.08 |
| B | 0.014 | 0.023 | 0.36 | 0.58 |
| B1 | 0.038 | 0.065 | 0.97 | 1.65 |
| C | 0.008 | 0.015 | 0.20 | 0.38 |
| E | 0.220 | 0.310 | 5.59 | 7.87 |
| E1 | 0.290 | 0.320 | 7.37 | 8.13 |
| e | 0.100 | | 2.54 | |
| L | 0.125 | 0.200 | 3.18 | 5.08 |
| L1 | 0.150 | --- | 0.00 | --- |
| Q | 0.015 | 0.070 | 0.38 | 1.78 |
| S | --- | 0.098 | --- | 2.49 |
| S1 | 0.005 | --- | 0.13 | --- |

|   | INCHES | | MILLIMETERS | | | |
|---|---|---|---|---|---|---|
|   | MIN | MAX | MIN | MAX | N | CASE |
| D | --- | 0.405 | --- | 10.29 | 8 | P:D4 |
| D | --- | 0.785 | --- | 19.94 | 14 | C:D1 |
| D | --- | 0.840 | --- | 21.34 | 16 | E:D2 |
| D | --- | 0.960 | --- | 24.38 | 18 | V:D6 |
| D | --- | 1.060 | --- | 26.92 | 20 | R:D8 |
| D | --- | 1.280 | --- | 32.51 | 24 | L:D9 |

NOTES:
1. CONTROLLING DIMENSION: INCH
2. MEETS 1835 CASE OUTLINE CONFIGURATION #1 AS SHOWN IN ABOVE TABLE
3. N = NUMBER OF PINS

*ИИ ΛΧΙИ*
120 SAN GABRIEL DR  SUNNYVALE CA 94086  FAX (408) 737 7194
PROPRIETARY INFORMATION
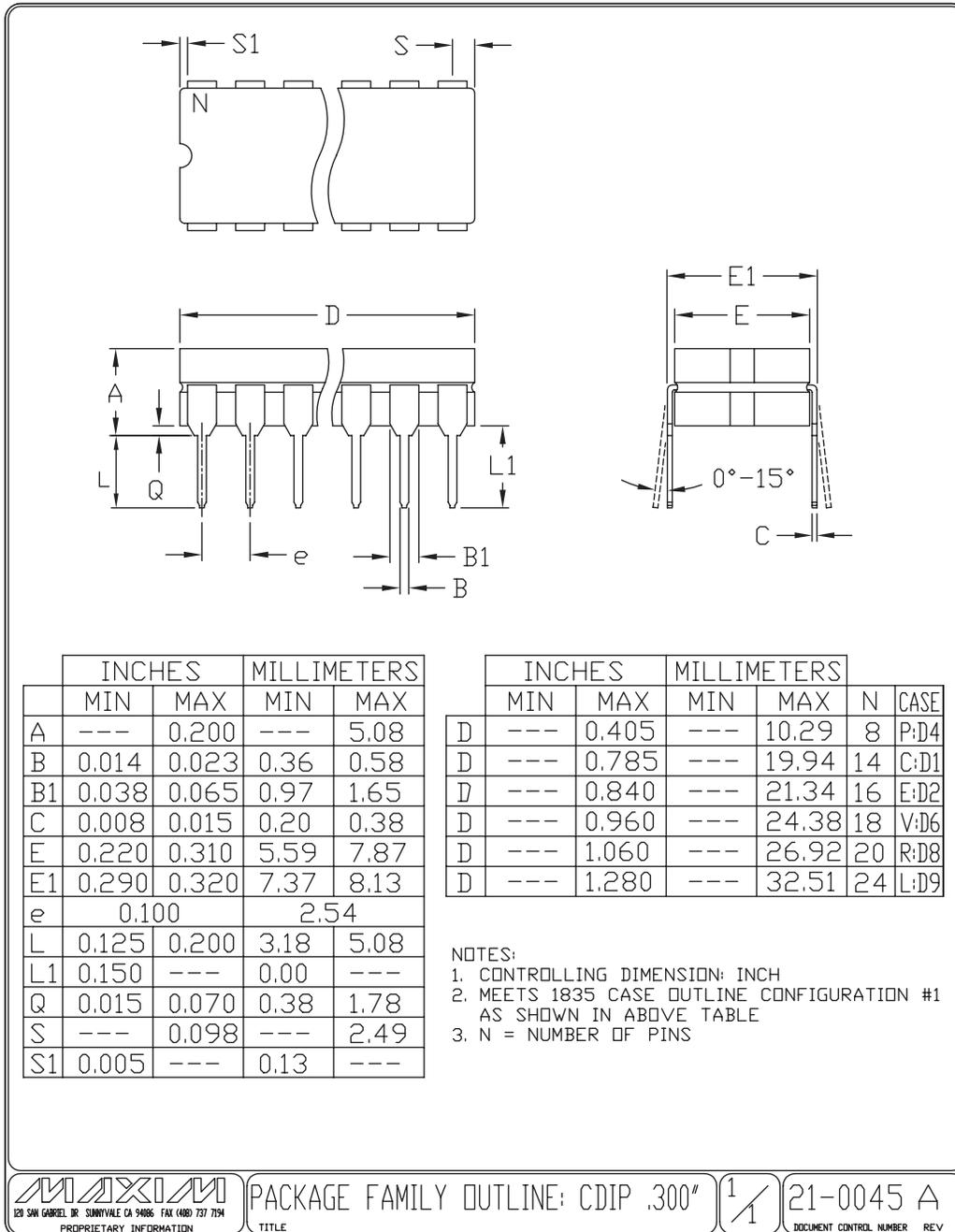
PACKAGE FAMILY OUTLINE: CDIP .300"
TITLE

1/1

21-0045 A
DOCUMENT CONTROL NUMBER   REV

*ИИ ΛΧΙИ*

## Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to **www.maxim-ic.com/packages**.)



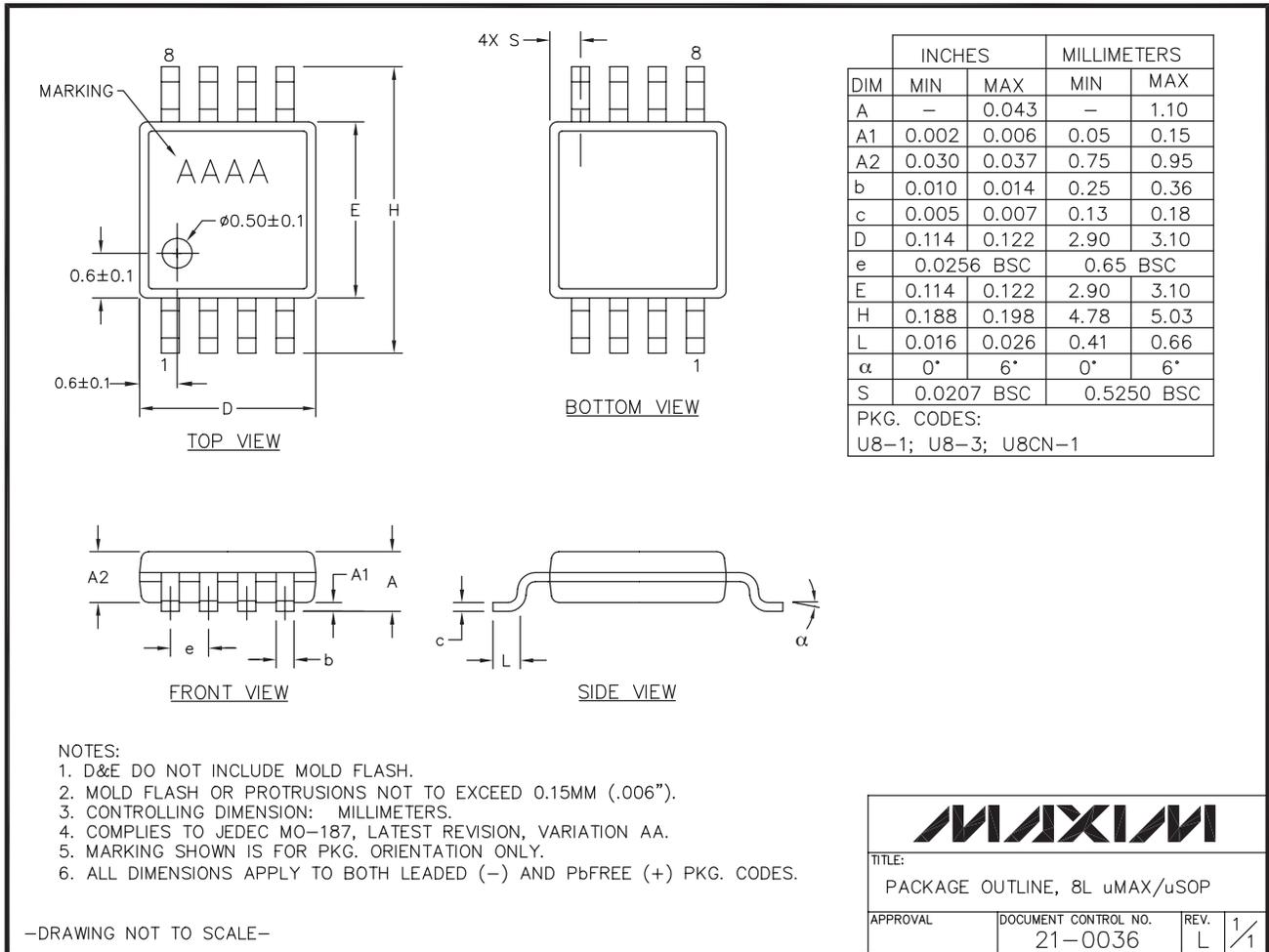| DIM | INCHES | | MILLIMETERS | |
|-----|--------|--------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | – | 0.043 | – | 1.10 |
| A1 | 0.002 | 0.006 | 0.05 | 0.15 |
| A2 | 0.030 | 0.037 | 0.75 | 0.95 |
| b | 0.010 | 0.014 | 0.25 | 0.36 |
| c | 0.005 | 0.007 | 0.13 | 0.18 |
| D | 0.114 | 0.122 | 2.90 | 3.10 |
| e | 0.0256 BSC | | 0.65 BSC | |
| E | 0.114 | 0.122 | 2.90 | 3.10 |
| H | 0.188 | 0.198 | 4.78 | 5.03 |
| L | 0.016 | 0.026 | 0.41 | 0.66 |
| α | 0° | 6° | 0° | 6° |
| S | 0.0207 BSC | | 0.5250 BSC | |

PKG. CODES:
U8−1;  U8−3;  U8CN−1

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15MM (.006").
3. CONTROLLING DIMENSION:   MILLIMETERS.
4. COMPLIES TO JEDEC MO−187, LATEST REVISION, VARIATION AA.
5. MARKING SHOWN IS FOR PKG. ORIENTATION ONLY.
6. ALL DIMENSIONS APPLY TO BOTH LEADED (−) AND PbFREE (+) PKG. CODES.

−DRAWING NOT TO SCALE−

**MAXIM**

TITLE:
PACKAGE OUTLINE, 8L uMAX/uSOP

| APPROVAL | DOCUMENT CONTROL NO. | REV. | |
|----------|---------------------|------|---|
| | 21−0036 | L | 1/1 |

**MAXIM**

13

## Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to **www.maxim-ic.com/packages**.)
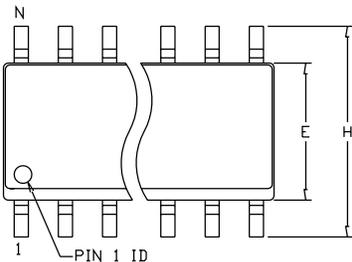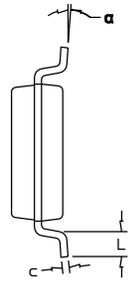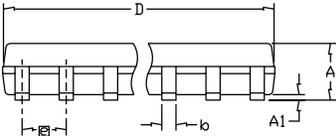


TOP VIEW    END VIEW    SIDE VIEW

| COMMON DIMENSIONS | | | | |
|---|---|---|---|---|
| SYMBOL | INCHES | | MM | |
| | MIN. | MAX. | MIN. | MAX. |
| A | .053 | .069 | 1.35 | 1.75 |
| A1 | .004 | .010 | 0.10 | 0.25 |
| b | .014 | .019 | 0.35 | 0.49 |
| c | .007 | .010 | 0.19 | 0.25 |
| E | .150 | .157 | 3.80 | 4.00 |
| e | .050 BSC | | 1.27 BSC | |
| H | .228 | .244 | 5.80 | 6.20 |
| L | .016 | .050 | 0.40 | 1.27 |
| α | 0° | 8° | 0° | 8° |

| VARIATION A | | | | |
|---|---|---|---|---|
| SYMBOL | INCHES | | MM | |
| | MIN. | MAX. | MIN. | MAX. |
| D | .189 | .197 | 4.80 | 5.00 |
| N | 8 | | | |
| MS012 | AA | | | |
| PKG. CODE | S8-2, S8-4, S8-5, S8-6F, S8-7F, S8-8F, S8-10F, S8-11F, S8-16F | | | |

| VARIATION B | | | | |
|---|---|---|---|---|
| SYMBOL | INCHES | | MM | |
| | MIN. | MAX. | MIN. | MAX. |
| D | .337 | .344 | 8.55 | 8.75 |
| N | 14 | | | |
| MS012 | AB | | | |
| PKG. CODE | S14-1, S14-4, S14-5, S14-6; S14M-4, S14M-5, S14M-6, S14M-7 | | | |

| VARIATION C | | | | |
|---|---|---|---|---|
| SYMBOL | INCHES | | MM | |
| | MIN. | MAX. | MIN. | MAX. |
| D | .386 | .394 | 9.80 | 10.00 |
| N | 16 | | | |
| MS012 | AC | | | |
| PKG. CODE | S16-1, S16-3, S16-5, S16-6, S16-8, S16-7F, S16-9F, S16-10F; S16M-3, S16M-6 | | | |

NOTES:

1.  ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.

2.  MATERIAL MUST COMPLY WITH BANNED AND RESTRICTED SUBSTANCES SPEC # 10-0131.

3.  DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE MOLD PROTRUSION IS 0.15 MM (.006") PER SIDE.

4.  LEADS TO BE COPLANAR WITHIN 0.10mm (.004").

5.  MEETS JEDEC MS012

6.  ALL DIMENSIONS APPLY TO BOTH LEADED (-) AND PbFREE (+) PKG. CODES.
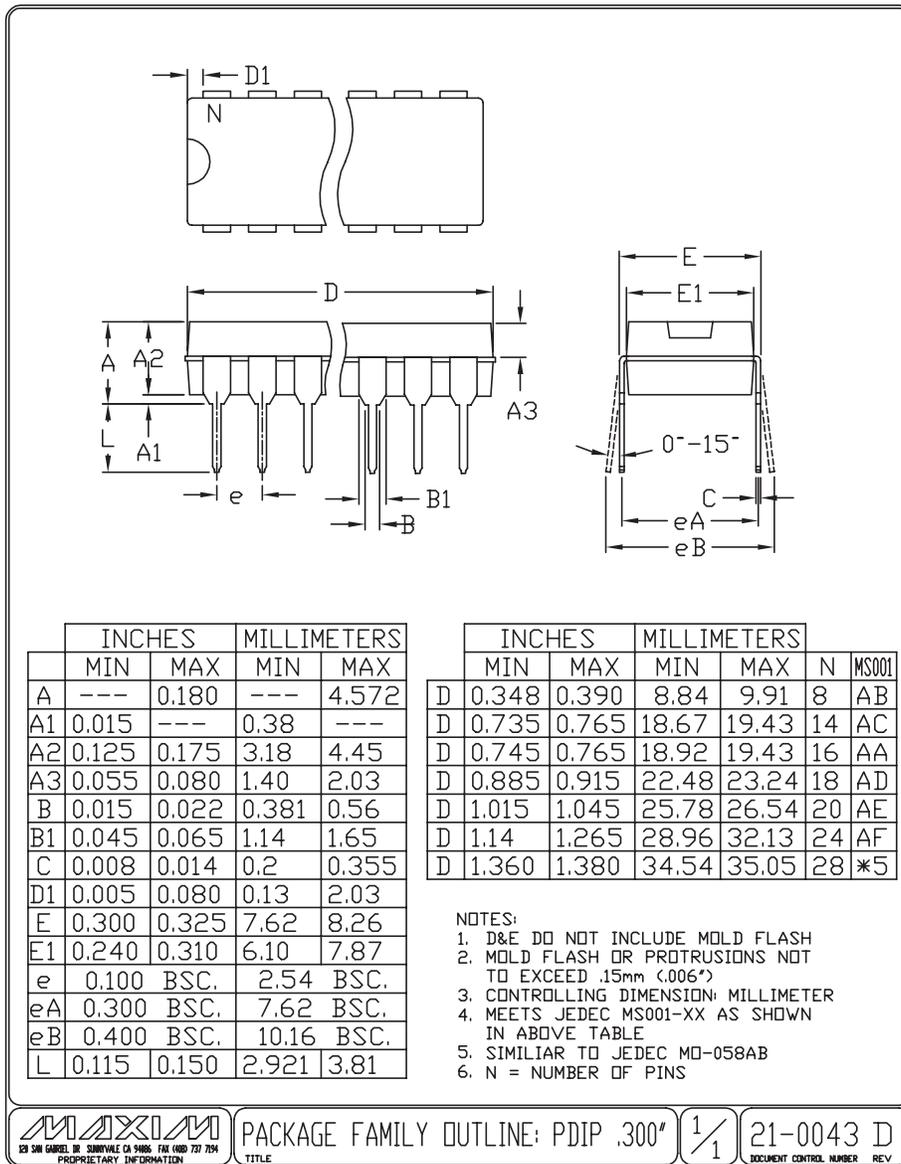
-DRAWING NOT TO SCALE-

**MAXIM**

| TITLE: PACKAGE OUTLINE, 8L, 14L, 16L SOIC .150 INCH | | | |
|---|---|---|---|
| APPROVAL | DOCUMENT CONTROL NO. 21-0041 | REV. C | 1/1 |

**MAXIM**

## Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to **www.maxim-ic.com/packages**.)

PDIPN.EPS



| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | --- | 0.180 | --- | 4.572 |
| A1 | 0.015 | --- | 0.38 | --- |
| A2 | 0.125 | 0.175 | 3.18 | 4.45 |
| A3 | 0.055 | 0.080 | 1.40 | 2.03 |
| B | 0.015 | 0.022 | 0.381 | 0.56 |
| B1 | 0.045 | 0.065 | 1.14 | 1.65 |
| C | 0.008 | 0.014 | 0.2 | 0.355 |
| D1 | 0.005 | 0.080 | 0.13 | 2.03 |
| E | 0.300 | 0.325 | 7.62 | 8.26 |
| E1 | 0.240 | 0.310 | 6.10 | 7.87 |
| e | 0.100 BSC. | | 2.54 BSC. | |
| eA | 0.300 BSC. | | 7.62 BSC. | |
| eB | 0.400 BSC. | | 10.16 BSC. | |
| L | 0.115 | 0.150 | 2.921 | 3.81 |

| | INCHES | | MILLIMETERS | | N | MS001 |
|---|---|---|---|---|---|---|
| | MIN | MAX | MIN | MAX | | |
| D | 0.348 | 0.390 | 8.84 | 9.91 | 8 | AB |
| D | 0.735 | 0.765 | 18.67 | 19.43 | 14 | AC |
| D | 0.745 | 0.765 | 18.92 | 19.43 | 16 | AA |
| D | 0.885 | 0.915 | 22.48 | 23.24 | 18 | AD |
| D | 1.015 | 1.045 | 25.78 | 26.54 | 20 | AE |
| D | 1.14 | 1.265 | 28.96 | 32.13 | 24 | AF |
| D | 1.360 | 1.380 | 34.54 | 35.05 | 28 | ✳5 |

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC MS001-XX AS SHOWN IN ABOVE TABLE
5. SIMILIAR TO JEDEC MO-058AB
6. N = NUMBER OF PINS

**/VI/XI/VI**
120 SAN GABRIEL DR. SUNNYVALE CA 94086  FAX (408) 737 7194
PROPRIETARY INFORMATION

PACKAGE FAMILY OUTLINE: PDIP .300"
TITLE

1/1

21-0043 D
DOCUMENT CONTROL NUMBER  REV

MAX706P/R/S/T, MAX706AP/AR/AS/AT, MAX708R/S/T

　　　Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические),  за  счёт заключения дистрибьюторских договоров

　　Мы предлагаем:

- Конкурентоспособные цены и скидки постоянным клиентам.
- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.

- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.

- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

　　В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

　Конструкторский отдел помогает осуществить:

- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.