19-0344; Rev 3; 3/98

MAXIM

# 3-Pin Microprocessor Reset Circuits



## General Description

The MAX809/MAX810 are microprocessor (µP) supervisory circuits used to monitor the power supplies in µP and digital systems. They provide excellent circuit reliability and low cost by eliminating external components and adjustments when used with 5V-powered or 3V-powered circuits.

These circuits perform a single function: They assert a reset signal whenever the $V_{CC}$ supply voltage declines below a preset threshold, keeping it asserted for at least 140ms after $V_{CC}$ has risen above the reset threshold. The only difference between the two devices is that the MAX809 has an active-low $\overline{RESET}$ output (which is guaranteed to be in the correct state for $V_{CC}$ down to 1V), while the MAX810 has an active-high RESET output. The reset comparator is designed to ignore fast transients on $V_{CC}$. Reset thresholds suitable for operation with a variety of supply voltages are available.

Low supply current makes the MAX809/MAX810 ideal for use in portable equipment. The MAX809/MAX810 come in a 3-pin SOT23 package.

## Applications

Computers

Controllers

Intelligent Instruments

Critical µP and µC Power Monitoring

Portable/Battery-Powered Equipment

Automotive

## Features

- **Precision Monitoring of 3V, 3.3V, and 5V Power-Supply Voltages**
- **Fully Specified Over Temperature**
- **140ms Min Power-On Reset Pulse Width**
  **$\overline{RESET}$ Output (MAX809)**
  **RESET Output (MAX810)**
- **17µA Supply Current**
- **Guaranteed $\overline{RESET}$ Valid to $V_{CC}$ = 1V (MAX809)**
- **Power Supply Transient Immunity**
- **No External Components**
- **3-Pin SOT23 Package**

## Ordering Information

| PART† | TEMP. RANGE | PIN-PACKAGE |
|---|---|---|
| **MAX809**_EUR-T | -40°C to +105°C | 3 SOT23-3 |
| MAX809_EUR-T10 | -40°C to +105°C | 3 SOT23-3 |

***Ordering Information continued at end of data sheet.***

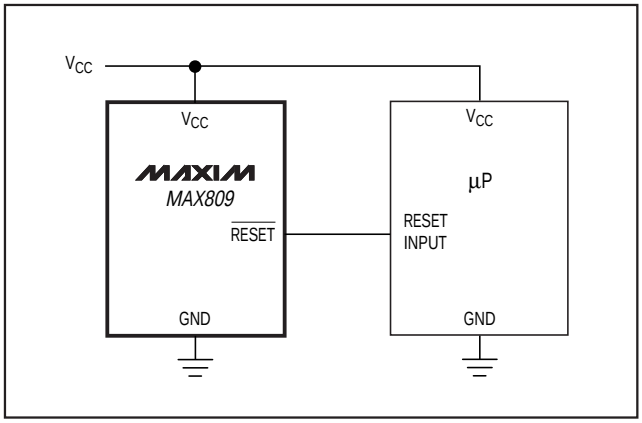
**Note:** *These parts are offered in 2.5k or 10k reels, and must be ordered in 2.5k or 10k increments. Order MAX809_EUR-T for 2.5k reels and MAX809_EUR-T10 for 10k reels.*

*†Insert the desired suffix letter (from the table below) into the blank to complete the part number:*

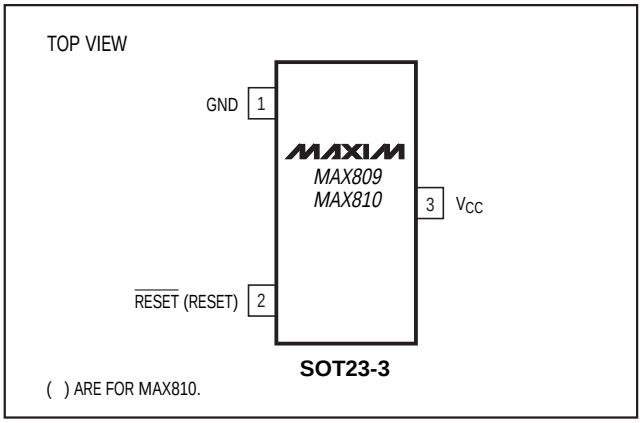
| SUFFIX | RESET THRESHOLD (V) | SOT TOP MARK | |
|---|---|---|---|
| | | MAX809 | MAX810 |
| L | 4.63 | AAAA | AGAA |
| M | 4.38 | ABAA | AHAA |
| J* | 4.00 | CWAA | — |
| T | 3.08 | ACAA | AJAA |
| S | 2.93 | ADAA | AKAA |
| R | 2.63 | AFAA | ALAA |

** J version is available for MAX809 only.*

## Typical Operating Circuit




## Pin Configuration



## ABSOLUTE MAXIMUM RATINGS

Terminal Voltage (with respect to GND)
$V_{CC}$ .....-0.3V to 6.0V
RESET, $\overline{RESET}$.....-0.3V to ($V_{CC}$ + 0.3V)
Input Current, $V_{CC}$ .....20mA
Output Current, RESET, $\overline{RESET}$ .....20mA
Rate of Rise, $V_{CC}$.....100V/µs

Continuous Power Dissipation ($T_A$ = +70°C)
SOT23 (derate above +70°C by 4mW/°C).....320mW
Operating Temperature Range .....-40°C to +105°C
Storage Temperature Range .....-65°C to +160°C
Lead Temperature (soldering, 10sec) .....+300°C

*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

($V_{CC}$ = full range, $T_A$ = -40°C to +105°C, unless otherwise noted. Typical values are at $T_A$ = +25°C, $V_{CC}$ = 5V for L/M/J versions, $V_{CC}$ = 3.3V for T/S versions, and $V_{CC}$ = 3V for R version.) (Note 1)

| PARAMETER | SYMBOL | CONDITIONS | | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|---|
| $V_{CC}$ Range | | $T_A$ = 0°C to +70°C | | | 1.0 | | 5.5 | V |
| | | $T_A$ = -40°C to +105°C | | | 1.2 | | 5.5 | |
| Supply Current | $I_{CC}$ | $T_A$ = -40°C to +85°C | $V_{CC}$ < 5.5V, MAX8_ _ L/M | | | 24 | 60 | µA |
| | | | $V_{CC}$ < 3.6V, MAX8_ _ R/S/T | | | 17 | 50 | |
| | | $T_A$ = +85°C to +105°C | $V_{CC}$ < 5.5V, MAX8_ _ L/M | | | | 100 | |
| | | | $V_{CC}$ < 3.6V, MAX8_ _ R/S/T | | | | 100 | |
| Reset Threshold (Note 2) | $V_{TH}$ | MAX8_ _L | | $T_A$ = +25°C | 4.56 | 4.63 | 4.70 | V |
| | | | | $T_A$ = -40°C to +85°C | 4.50 | | 4.75 | |
| | | | | $T_A$ = +85°C to +105°C | 4.40 | | 4.86 | |
| | | MAX8_ _M | | $T_A$ = +25°C | 4.31 | 4.38 | 4.45 | |
| | | | | $T_A$ = -40°C to +85°C | 4.25 | | 4.50 | |
| | | | | $T_A$ = +85°C to +105°C | 4.16 | | 4.56 | |
| | | MAX809J | | $T_A$ = +25°C | 3.93 | 4.00 | 4.06 | |
| | | | | $T_A$ = -40°C to +85°C | 3.89 | | 4.10 | |
| | | | | $T_A$ = +85°C to +105°C | 3.80 | | 4.20 | |
| | | MAX8_ _T | | $T_A$ = +25°C | 3.04 | 3.08 | 3.11 | |
| | | | | $T_A$ = -40°C to +85°C | 3.00 | | 3.15 | |
| | | | | $T_A$ = +85°C to +105°C | 2.92 | | 3.23 | |
| | | MAX8_ _S | | $T_A$ = +25°C | 2.89 | 2.93 | 2.96 | |
| | | | | $T_A$ = -40°C to +85°C | 2.85 | | 3.00 | |
| | | | | $T_A$ = +85°C to +105°C | 2.78 | | 3.08 | |
| | | MAX8_ _R | | $T_A$ = +25°C | 2.59 | 2.63 | 2.66 | |
| | | | | $T_A$ = -40°C to +85°C | 2.55 | | 2.70 | |
| | | | | $T_A$ = +85°C to +105°C | 2.50 | | 2.76 | |
| Reset Threshold Tempco | | | | | | 30 | | ppm/°C |
| $V_{CC}$ to Reset Delay (Note 2) | | $V_{CC}$ = $V_{TH}$ to ($V_{TH}$ - 100mV) | | | | 20 | | µs |
| Reset Active Timeout Period | | $T_A$ = -40°C to +85°C | | | 140 | 240 | 560 | ms |
| | | $T_A$ = +85°C to +105°C | | | 100 | | 840 | |
| $\overline{RESET}$ Output Voltage Low (MAX809) | $V_{OL}$ | $V_{CC}$ = $V_{TH}$ min, $I_{SINK}$ = 1.2mA, MAX809R/S/T | | | | | 0.3 | V |
| | | $V_{CC}$ = $V_{TH}$ min, $I_{SINK}$ = 3.2mA, MAX809L/M | | | | | 0.4 | |
| | | $V_{CC}$ > 1.0V, $I_{SINK}$ = 50µA | | | | | 0.3 | |

## ELECTRICAL CHARACTERISTICS (continued)

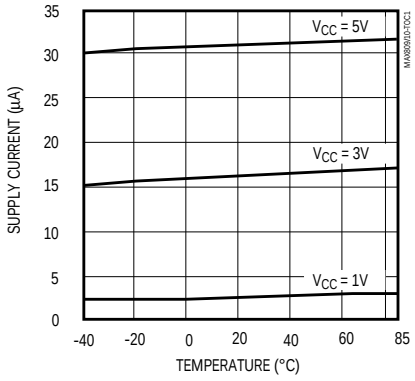
($V_{CC}$ = full range, $T_A$ = -40°C to +105°C, unless otherwise noted. Typical values are at $T_A$ = +25°C, $V_{CC}$ = 5V for L/M/J versions, $V_{CC}$ = 3.3V for T/S versions, and $V_{CC}$ = 3V for R version.) (Note 1)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| $\overline{RESET}$ Output Voltage High (MAX809) | $V_{OH}$ | $V_{CC}$ > $V_{TH}$ max, $I_{SOURCE}$ = 500µA, MAX809R/S/T | 0.8$V_{CC}$ | | | V |
| | | $V_{CC}$ > $V_{TH}$ max, $I_{SOURCE}$ = 800µA, MAX809L/M | $V_{CC}$ - 1.5 | | | |
| RESET Output Voltage Low (MAX810) | $V_{OL}$ | $V_{CC}$ = $V_{TH}$ max, $I_{SINK}$ = 1.2mA, MAX810R/S/T | | | 0.3 | V |
| | | $V_{CC}$ = $V_{TH}$ max, $I_{SINK}$ = 3.2mA, MAX810L/M | | | 0.4 | |
| RESET Output Voltage High (MAX810) | $V_{OH}$ | 1.8V < $V_{CC}$ < $V_{TH}$ min, $I_{SOURCE}$ = 150µA | 0.8$V_{CC}$ | | | V |

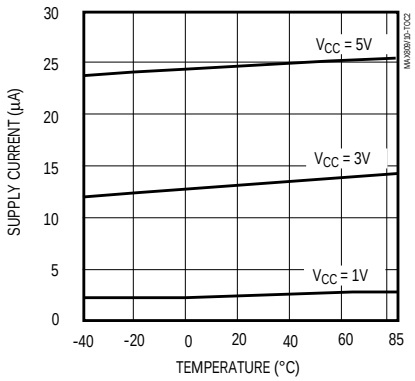
**Note 1:** Production testing done at $T_A$ = +25°C, over temperature limits guaranteed by design only.
**Note 2:** $\overline{RESET}$ Output for MAX809, RESET Output for MAX810.

## Typical Operating Characteristics

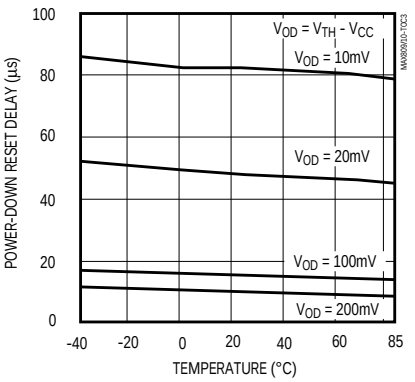
**SUPPLY CURRENT vs. TEMPERATURE (NO LOAD, MAX8_ _R/S/T)**



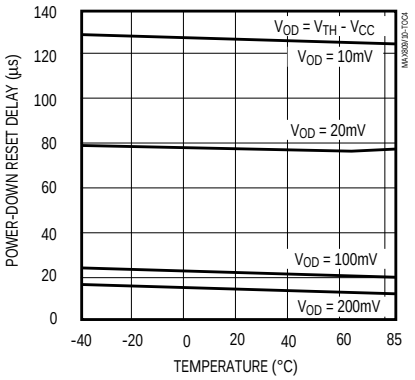

**SUPPLY CURRENT vs. TEMPERATURE (NO LOAD, MAX8_ _L/M)**



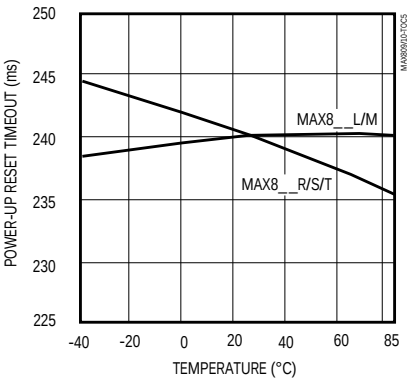

**POWER-DOWN RESET DELAY vs. TEMPERATURE (MAX8_ _R/S/T)**



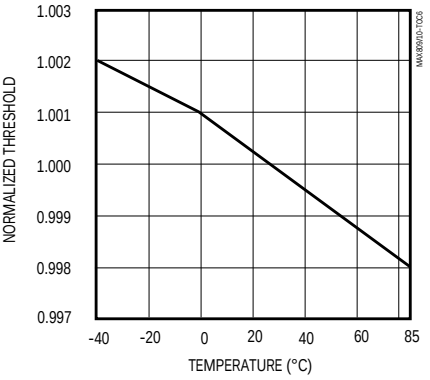

**POWER-DOWN RESET DELAY vs. TEMPERATURE (MAX8_ _L/M)**




**POWER-UP RESET TIMEOUT vs. TEMPERATURE**




**NORMALIZED RESET THRESHOLD vs. TEMPERATURE**



## Pin Description

| PIN | NAME | FUNCTION |
|---|---|---|
| 1 | GND | Ground |
| 2 | $\overline{\text{RESET}}$ (MAX809) | $\overline{\text{RESET}}$ Output remains low while $V_{CC}$ is below the reset threshold, and for 240ms after $V_{CC}$ rises above the reset threshold. |
| | RESET (MAX810) | RESET Output remains high while $V_{CC}$ is below the reset threshold, and for 240ms after $V_{CC}$ rises above the reset threshold. |
| 3 | $V_{CC}$ | Supply Voltage (+5V, +3.3V, or +3.0V) |

## Applications Information

### Negative-Going $V_{CC}$ Transients

In addition to issuing a reset to the microprocessor (µP) during power-up, power-down, and brownout conditions, the MAX809/MAX810 are relatively immune to short duration negative-going $V_{CC}$ transients (glitches).

Figure 1 shows typical transient duration vs. reset comparator overdrive, for which the MAX809/MAX810 do **not** generate a reset pulse. The graph was generated using a negative-going pulse applied to $V_{CC}$, starting 0.5V above the actual reset threshold and ending below it by the magnitude indicated (reset comparator overdrive). The graph indicates the maximum pulse width a negative-going $V_{CC}$ transient can have without causing a reset pulse. As the magnitude of the transient increases (goes farther below the reset threshold), the maximum allowable pulse width decreases. Typically, for the MAX809L and MAX810M, a $V_{CC}$ transient that goes 100mV below the reset threshold and lasts 20µs or less will not cause a reset pulse. A 0.1µF bypass capacitor mounted as close as possible to the $V_{CC}$ pin provides additional transient immunity.

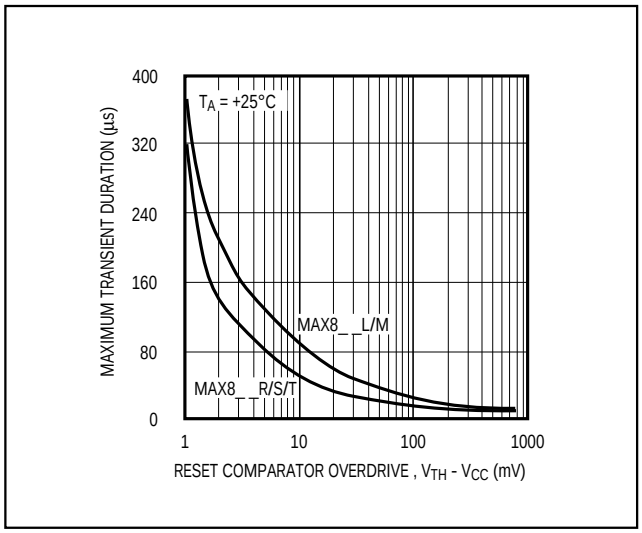



*Figure 1. Maximum Transient Duration without Causing a Reset Pulse vs. Reset Comparator Overdrive*

### Ensuring a Valid Reset Output Down to $V_{CC}$ = 0V

When $V_{CC}$ falls below 1V, the MAX809 $\overline{\text{RESET}}$ output no longer sinks current—it becomes an open circuit. Therefore, high-impedance CMOS logic inputs connected to $\overline{\text{RESET}}$ can drift to undetermined voltages. This presents no problem in most applications, since most µP and other circuitry is inoperative with $V_{CC}$ below 1V. However, in applications where $\overline{\text{RESET}}$ must be valid down to 0V, adding a pull-down resistor to $\overline{\text{RESET}}$ causes any stray leakage currents to flow to ground, holding $\overline{\text{RESET}}$ low (Figure 2). R1's value is not critical; 100kΩ is large enough not to load $\overline{\text{RESET}}$ and small enough to pull $\overline{\text{RESET}}$ to ground.

A 100kΩ pull-up resistor to $V_{CC}$ is also recommended for the MAX810, if RESET is required to remain valid for $V_{CC}$ < 1V.

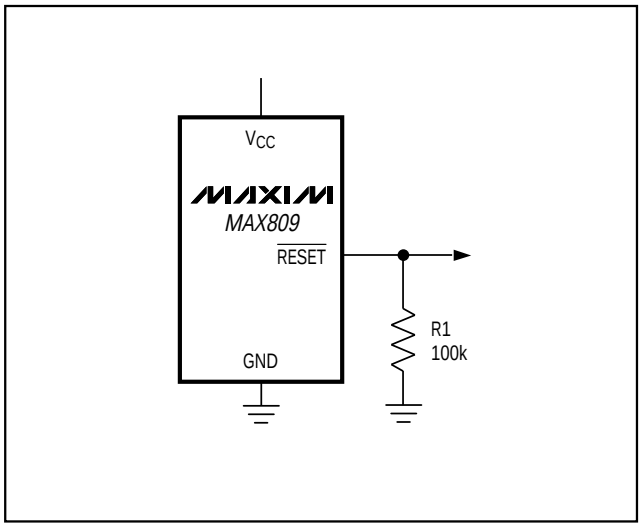



*Figure 2. $\overline{RESET}$ Valid to $V_{CC}$ = Ground Circuit*

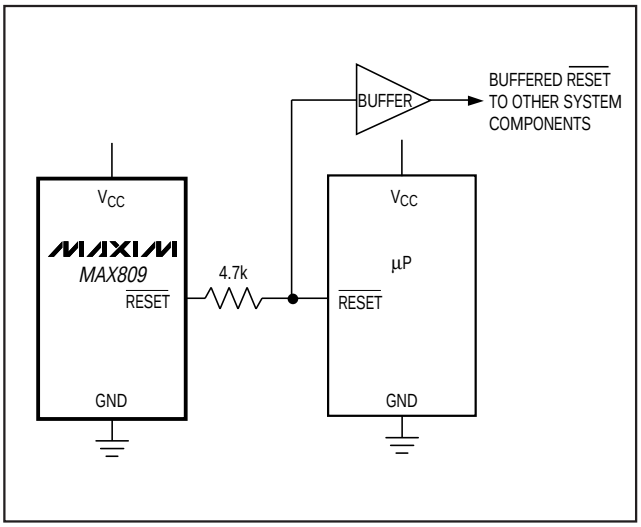



*Figure 3. Interfacing to µPs with Bidirectional Reset I/O*

### *Interfacing to µPs with Bidirectional Reset Pins*

µPs with bidirectional reset pins (such as the Motorola 68HC11 series) can connect to the MAX809 reset output. If, for example, the MAX809 $\overline{RESET}$ output is asserted high and the µP wants to pull it low, indeterminate logic levels may result. To correct this, connect a 4.7kΩ resistor between the MAX809 $\overline{RESET}$ output and the µP reset I/O (Figure 3). Buffer the MAX809 $\overline{RESET}$ output to other system components.

### *Benefits of Highly Accurate Reset Threshold*

Most µP supervisor ICs have reset threshold voltages between 5% and 10% below the value of nominal supply voltages. This ensures a reset will **not** occur within 5% of the nominal supply, but **will** occur when the supply is 10% below nominal.

When using ICs rated at only the nominal supply ±5%, this leaves a zone of uncertainty where the supply is between 5% and 10% low, and where the reset may or may not be asserted.

The MAX809L/T and MAX810L/T use highly accurate circuitry to ensure that reset is asserted close to the 5% limit, and long before the supply has declined to 10% below nominal.

## *Chip Information*

TRANSISTOR COUNT: 275

## *Ordering Information (continued)*

| PART† | TEMP. RANGE | PIN-PACKAGE |
|---|---|---|
| **MAX810**_EUR-T | -40°C to +105°C | 3 SOT23-3 |
| MAX810_EUR-T10 | -40°C to +105°C | 3 SOT23-3 |

**Note:** *These parts are offered in 2.5k or 10k reels, and must be ordered in 2.5k or 10k increments. Order MAX809_EUR-T for 2.5k reels and MAX809_EUR-T10 for 10k reels.*

*†Insert the desired suffix letter (from the table below) into the blank to complete the part number:*

| SUFFIX | RESET THRESHOLD (V) | SOT TOP MARK | |
|---|---|---|---|
| | | MAX809 | MAX810 |
| L | 4.63 | AAAA | AGAA |
| M | 4.38 | ABAA | AHAA |
| J* | 4.00 | CWAA | — |
| T | 3.08 | ACAA | AJAA |
| S | 2.93 | ADAA | AKAA |
| R | 2.63 | AFAA | ALAA |

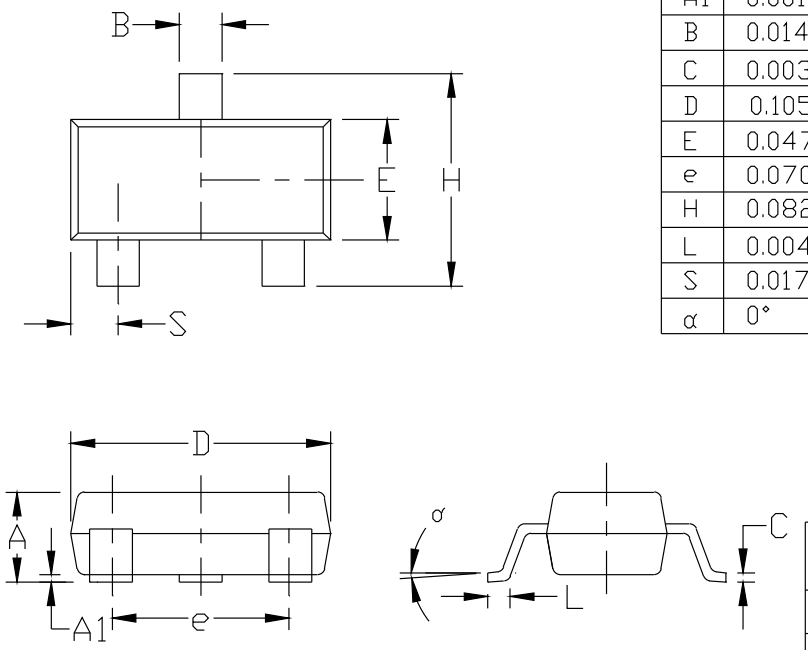
** J version is available for MAX809 only.*

## Package Information

SOTPO3L.EPS

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. CONTROLLING DIMENSION: MILLIMETER

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.031 | 0.047 | 0.787 | 1.194 |
| A1 | 0.001 | 0.005 | 0.025 | 0.127 |
| B | 0.014 | 0.022 | 0.356 | 0.559 |
| C | 0.0034 | 0.006 | 0.086 | 0.152 |
| D | 0.105 | 0.120 | 2.667 | 3.048 |
| E | 0.047 | 0.055 | 1.194 | 1.397 |
| e | 0.070 | 0.080 | 1.778 | 2.032 |
| H | 0.082 | 0.098 | 2.083 | 2.489 |
| L | 0.004 | 0.012 | 0.102 | 0.305 |
| S | 0.017 | 0.022 | 0.432 | 0.559 |
| α | 0° | 8° | 0° | 8° |




MAXIM
PROPRIETARY INFORMATION

TITLE:
PACKAGE OUTLINE,SOT-23, 3L

| APPROVAL | DOCUMENT CONTROL NO. | REV | |
|---|---|---|---|
| | 21-0051 | C | 1/1 |