19-1411; Rev 0; 12/98

MAXIM

# 3-Pin, Ultra-Low-Voltage, Low-Power µP Reset Circuits



## General Description

The MAX6332/MAX6333/MAX6334 microprocessor (µP) supervisory circuits monitor the power supplies in 1.8V to 3.3V µP and digital systems. They increase circuit reliability and reduce cost by eliminating external components and adjustments.

These devices perform a single function: they assert a reset signal whenever the $V_{CC}$ supply voltage declines below a preset threshold, keeping it asserted for a preset timeout period after $V_{CC}$ has risen above the reset threshold. The only difference among the three devices is their output. The MAX6333 (push/pull) and MAX6334 (open-drain) have an active-low $\overline{RESET}$ output, while the MAX6332 (push/pull) has an active-high RESET output. The MAX6332/MAX6333 are guaranteed to be in the correct state for $V_{CC}$ down to 0.7V. The MAX6334 is guaranteed to be in the correct state for $V_{CC}$ down to 1.0V.

The reset comparator in these ICs is designed to ignore fast transients on $V_{CC}$. Reset thresholds are factory-trimmable between 1.6V and 2.5V, in approximately 100mV increments. There are 15 standard versions available (2,500 piece minimum-order quantity); contact the factory for availability of nonstandard versions (10,000 piece minimum-order quantity). For space-critical applications, the MAX6332/MAX6333/MAX6334 come packaged in a 3-pin SOT23.

## Applications

Pentium II™ Computers

Computers

Controllers

Intelligent Instruments

Critical µP/µC Power Monitoring

Portable/Battery-Powered Equipment

Automotive

***Typical Operating Circuit and Pin Configuration appear at end of data sheet.***

***Selector Guide appears at end of data sheet.***

*Pentium II is a trademark of Intel Corp.*

## Features

- ♦ **Ultra-Low 0.7V Operating Supply Voltage**
- ♦ **Low 3.3µA Supply Current**
- ♦ **Precision Monitoring of 1.8V and 2.5V Power-Supply Voltages**
- ♦ **Reset Thresholds Available from 1.6V to 2.5V, in Approximately 100mV Increments**
- ♦ **Fully Specified over Temperature**
- ♦ **Three Power-On Reset Pulse Widths Available (1ms min, 20ms min, 100ms min)**
- ♦ **Low Cost**
- ♦ **Three Available Output Structures: Push/Pull $\overline{RESET}$, Push/Pull RESET, Open-Drain $\overline{RESET}$**
- ♦ **Guaranteed RESET/$\overline{RESET}$ Valid to $V_{CC}$ = 0.7V (MAX6332/MAX6333)**
- ♦ **Power-Supply Transient Immunity**
- ♦ **No External Components**
- ♦ **3-Pin SOT23 Package**
- ♦ **Pin-Compatible with MAX809/MAX810 and MAX6326/MAX6327/MAX6328**

## Ordering Information

| PART* | TEMP. RANGE | PIN-PACKAGE |
|---|---|---|
| **MAX6332**UR__D_-T | -40°C to +85°C | 3 SOT23-3 |
| **MAX6333**UR__D_-T | -40°C to +85°C | 3 SOT23-3 |
| **MAX6334**UR__D_-T | -40°C to +85°C | 3 SOT23-3 |

** These devices are available in factory-set $V_{CC}$ reset thresholds from 1.6V to 2.5V, in approximately 0.1V increments. Choose the desired reset threshold suffix from Table 1 and insert it in the blanks following "UR" in the part number. Factory-programmed reset timeout periods are also available. Insert the number corresponding to the desired nominal reset timeout period (1 = 1ms min, 2 = 20ms min, 3 = 100ms min) in the blank following "D" in the part number. There are 15 standard versions with a required order increment of 2500 pieces. Sample stock is generally held on the standard versions only (see Selector Guide). Contact the factory for availability of nonstandard versions (required order increment is 10,000 pieces). All devices available in tape-and-reel only.*

# 3-Pin, Ultra-Low-Voltage, Low-Power µP Reset Circuits

## ABSOLUTE MAXIMUM RATINGS

Terminal Voltage (with respect to GND)
- $V_{CC}$ .....-0.3V to +6V
- Push/Pull RESET, $\overline{RESET}$ .....-0.3V to ($V_{CC}$ + 0.3V)
- Open-Drain $\overline{RESET}$ .....-0.3V to +6V

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)
- SOT23-3 (derate 4mW/°C above +70°C) .....320mW

Operating Temperature Range .....-40°C to +85°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 +85°C, unless otherwise noted. Typical values are at $T_A$ = +25°C and $V_{CC}$ = 3V, reset not asserted.)

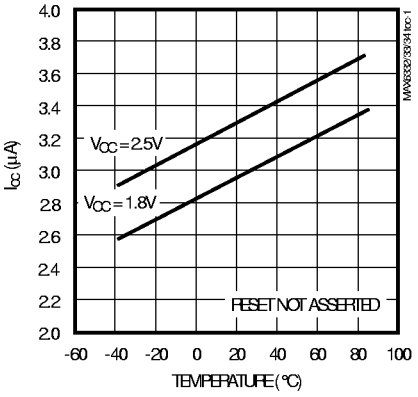
| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Supply Voltage Range | $V_{CC}$ | $T_A$ = 0°C to +85°C | MAX6332/MAX6333 | 0.7 | | 5.5 | V |
| | | | MAX6334 | 1.0 | | 5.5 | |
| | | $T_A$ = -40°C to +85°C | MAX6332/MAX6333 | 0.78 | | 5.5 | |
| | | | MAX6334 | 1.2 | | 5.5 | |
| Supply Current | $I_{CC}$ | No load | $V_{CC}$ = 1.8V | | 3.0 | 6.0 | µA |
| | | | $V_{CC}$ = 2.5V | | 3.3 | 7.0 | |
| Reset Threshold | $V_{TH}$ | MAX633_UR__D_-T, Table 1 | $T_A$ = +25°C | $V_{TH}$ - 1.8% | $V_{TH}$ | $V_{TH}$ + 1.8% | V |
| | | | $T_A$ = -40°C to +85°C | $V_{TH}$ - 3% | $V_{TH}$ | $V_{TH}$ + 3% | |
| $V_{CC}$ Falling Reset Delay | | $V_{CC}$ falling at 10V/ms | | | 24 | | µs |
| Reset Active Timeout Period | $t_{RP}$ | MAX633_UR__D1-T | | 1 | 1.5 | 2 | ms |
| | | MAX633_UR__D2-T | | 20 | 30 | 40 | |
| | | MAX633_UR__D3-T | | 100 | 150 | 200 | |
| $\overline{RESET}$ Output Low Voltage (MAX6333/MAX6334) | $V_{OL}$ | Reset asserted | $I_{SINK}$ = 50µA, $V_{CC}$ ≥ 1.0V | | | 0.4 | V |
| | | | $I_{SINK}$ = 500µA, $V_{CC}$ ≥ 1.8V | | | 0.3 | |
| $\overline{RESET}$ Output High Voltage (MAX6333) | $V_{OH}$ | Reset not asserted | $I_{SOURCE}$ = 200µA, $V_{CC}$ ≥ 1.8V | 0.8$V_{CC}$ | | | V |
| | | | $I_{SOURCE}$ = 500µA, $V_{CC}$ ≥ 2.7V | 0.8$V_{CC}$ | | | |
| RESET Output Voltage (MAX6332) | $V_{OH}$ | Reset asserted | $I_{SOURCE}$ = 1µA, $V_{CC}$ ≥ 1.0V | 0.8$V_{CC}$ | | | V |
| | | | $I_{SOURCE}$ = 200µA, $V_{CC}$ ≥ 1.8V | 0.8$V_{CC}$ | | | |
| | $V_{OL}$ | Reset not asserted | $I_{SINK}$ = 500µA, $V_{CC}$ ≥ 1.8V | | | 0.3 | V |
| | | | $I_{SINK}$ = 1.2mA, $V_{CC}$ ≥ 2.7V | | | 0.3 | |
| $\overline{RESET}$ Output Leakage Current (MAX6334) | | $V_{CC}$ > $V_{TH}$, $\overline{RESET}$ deasserted | | | | 0.5 | µA |

# 3-Pin, Ultra-Low-Voltage, Low-Power µP Reset Circuits

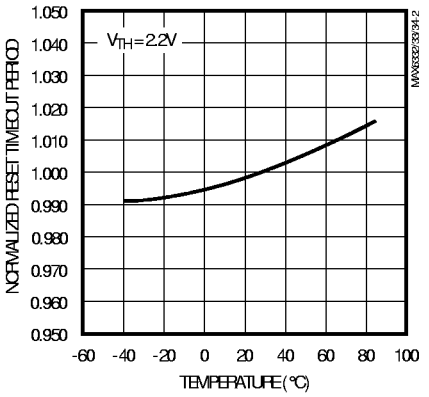
## Typical Operating Characteristics

(Reset not asserted, $T_A$ = +25°C, unless otherwise noted.)

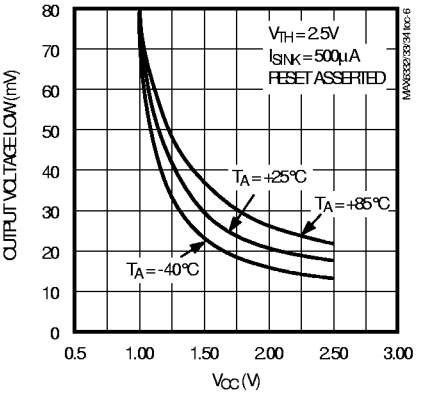
SUPPLY CURRENT vs. TEMPERATURE



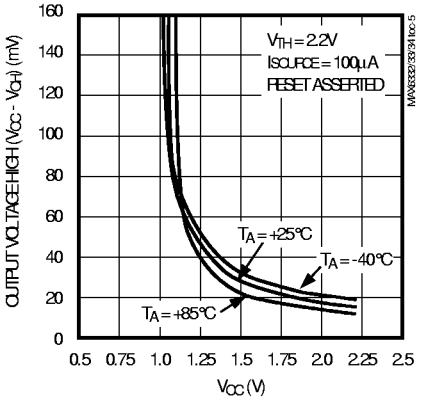

NORMALIZED RESET TIMEOUT PERIOD vs. TEMPERATURE



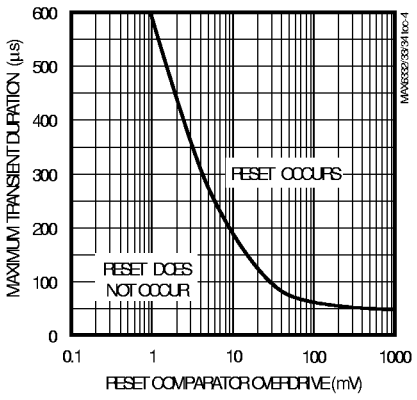

OUTPUT VOLTAGE LOW vs. SUPPLY VOLTAGE



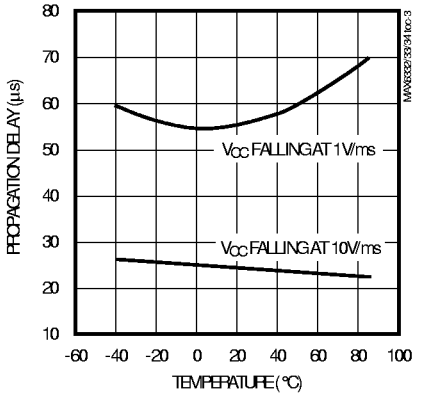

OUTPUT VOLTAGE HIGH vs. SUPPLY VOLTAGE




MAXIMUM TRANSIENT DURATION vs. RESET COMPARATOR OVERDRIVE




VCC FALLING PROPAGATION DELAY vs. TEMPERATURE




## Pin Description

| PIN | | NAME | FUNCTION |
|---|---|---|---|
| MAX6332 | MAX6333 MAX6334 | | |
| 1 | 1 | GND | Ground |
| — | 2 | $\overline{\text{RESET}}$ | Active-Low Reset Output. $\overline{\text{RESET}}$ remains low while $V_{CC}$ is below the reset threshold and for a reset timeout period ($t_{RP}$) after $V_{CC}$ rises above the reset threshold. $\overline{\text{RESET}}$ on the MAX6334 is open-drain. |
| 2 | — | RESET | Active-High Reset Output. RESET remains high while $V_{CC}$ is below the reset threshold and for a reset timeout period ($t_{RP}$) after $V_{CC}$ rises above the reset threshold. |
| 3 | 3 | $V_{CC}$ | Supply Voltage (0.7V to 5.5V) |

# 3-Pin, Ultra-Low-Voltage, Low-Power µP Reset Circuits

## Applications Information

### Interfacing to µPs with Bidirectional Reset Pins

Since the RESET output on the MAX6334 is open-drain, this device interfaces easily with µPs that have bidirectional reset pins, such as the Motorola 68HC11. Connecting the µP supervisor's RESET output directly to the microcontroller's (µC's) RESET pin with a single pull-up resistor allows either device to assert reset (Figure 1).

### Negative-Going VCC Transients

In addition to issuing a reset to the µP during power-up, power-down, and brownout conditions, these devices are relatively immune to short-duration, negative-going VCC transients (glitches). The *Typical Operating Characteristics* show the Maximum Transient Duration vs. Reset Comparator Overdrive graph. The graph shows the maximum pulse width that a negative-going VCC transient may typically have without issuing a reset signal. As the amplitude of the transient increases, the maximum allowable pulse width decreases.

### Ensuring a Valid Reset Output Down to VCC = 0

When VCC falls below 1V and approaches the minimum operating voltage of 0.7V, push/pull-structured reset sinking (or sourcing) capabilities decrease drastically. High-impedance CMOS-logic inputs connected to the RESET pin can drift to indeterminate voltages. This does not present a problem in most cases, since most µPs and circuitry do not operate at VCC below 1V. For the MAX6333, where RESET must be valid down to 0, adding a pull-down resistor between RESET and GND removes stray leakage currents, holding RESET low (Figure 2a). The pull-down resistor value is not critical; 100kΩ is large enough not to load RESET and small enough to pull it low. For the MAX6332, where RESET must be valid to VCC = 0, a 100kΩ pull-up resistor between RESET and VCC will hold RESET high when VCC falls below 0.7V (Figure 2b).

Since the MAX6334 has an open-drain, active-low output, it typically uses a pull-up resistor. With this device, RESET will most likely not maintain an active condition, but will drift to a non-active level due to the pull-up resistor and the reduced sinking capability of the open-drain device. Therefore, this device is not recommended for applications where the RESET pin is required to be valid down to VCC = 0.

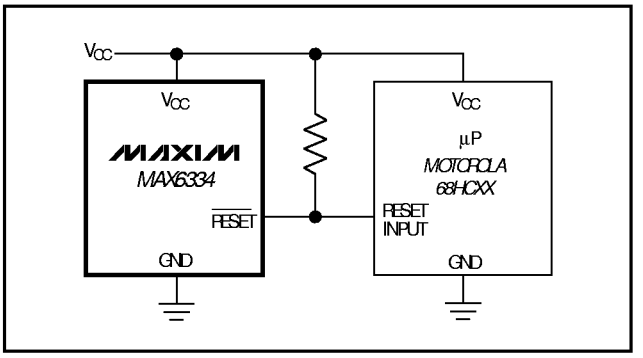



*Figure 1. Interfacing to µPs with Bidirectional Reset Pins*

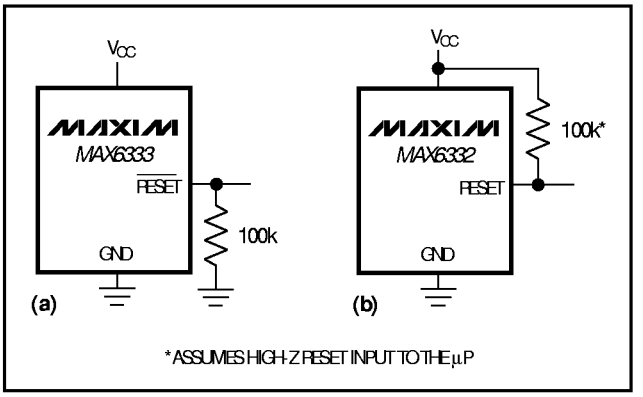



*Figure 2. Ensuring Reset Valid Down to VCC = 0*

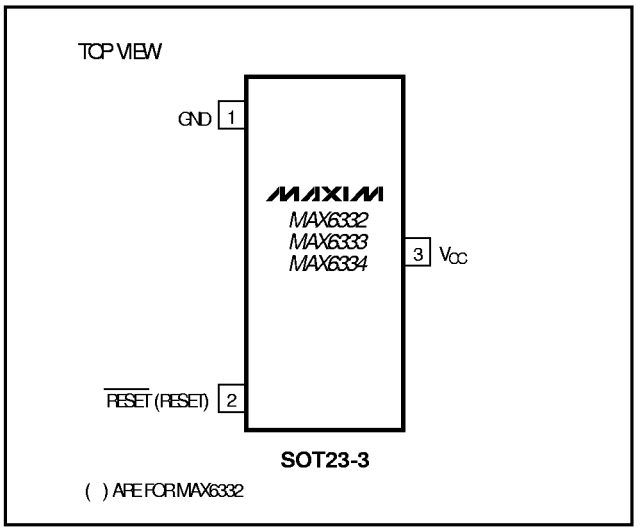
## Table 1. Factory-Trimmed Reset Thresholds*

| RESET-THRESHOLD SUFFIX | TA = +25°C | | | TA = -40°C to +85°C | |
|---|---|---|---|---|---|
| | MIN | TYP | MAX | MIN | MAX |
| MAX633_UR25D_ | 2.46 | 2.50 | 2.55 | 2.43 | 2.58 |
| MAX633_UR24D_ | 2.36 | 2.40 | 2.44 | 2.33 | 2.47 |
| MAX633_UR23D_ | 2.26 | 2.30 | 2.34 | 2.23 | 2.37 |
| MAX633_UR22D_ | 2.16 | 2.20 | 2.24 | 2.13 | 2.27 |
| MAX633_UR21D_ | 2.06 | 2.10 | 2.14 | 2.04 | 2.16 |
| MAX633_UR20D_ | 1.96 | 2.00 | 2.04 | 1.94 | 2.06 |
| MAX633_UR19D_ | 1.87 | 1.90 | 1.93 | 1.84 | 1.96 |
| MAX633_UR18D_ | 1.77 | 1.80 | 1.83 | 1.75 | 1.85 |
| MAX633_UR17D_ | 1.67 | 1.70 | 1.73 | 1.65 | 1.75 |
| MAX633_UR16D_ | 1.57 | 1.60 | 1.63 | 1.55 | 1.65 |

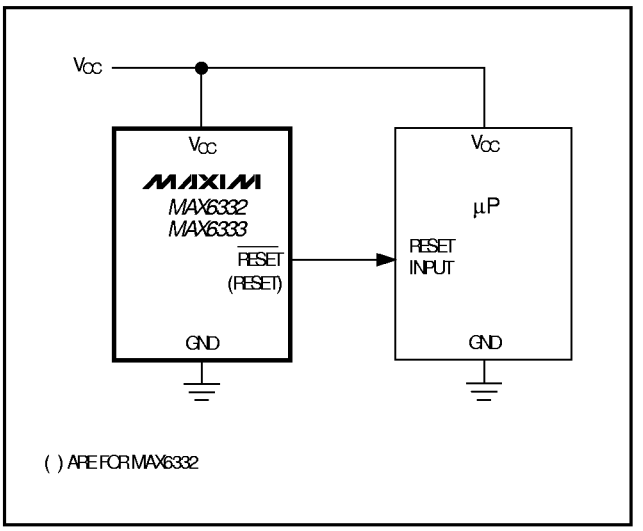
** Factory-trimmed reset thresholds are available in approximately 100mV increments, with a ±1.8% room-temperature variance.*

# 3-Pin, Ultra-Low-Voltage, Low-Power µP Reset Circuits

## Pin Configuration




## Typical Operating Circuit




## Selector Guide (standard versions*)

| PART | OUTPUT STAGE | NOMINAL $V_{TH}$ (V) | MINIMUM RESET TIMEOUT (ms) | SOT TOP MARK |
|---|---|---|---|---|
| **MAX6332**UR23D3-T | Push/Pull RESET | 2.30 | 100 | FZDM |
| MAX6332UR22D3-T | Push/Pull RESET | 2.20 | 100 | FZCN |
| MAX6332UR20D3-T | Push/Pull RESET | 2.00 | 100 | FZDL |
| MAX6332UR18D3-T | Push/Pull RESET | 1.80 | 100 | FZCM |
| MAX6332UR16D3-T | Push/Pull RESET | 1.60 | 100 | FZCL |
| **MAX6333**UR23D3-T | Push/Pull $\overline{\text{RESET}}$ | 2.30 | 100 | FZCS |
| MAX6333UR22D3-T | Push/Pull $\overline{\text{RESET}}$ | 2.20 | 100 | FZCR |
| MAX6333UR20D3-T | Push/Pull $\overline{\text{RESET}}$ | 2.00 | 100 | FZCQ |
| MAX6333UR18D3-T | Push/Pull $\overline{\text{RESET}}$ | 1.80 | 100 | FZCP |
| MAX6333UR16D3-T | Push/Pull $\overline{\text{RESET}}$ | 1.60 | 100 | FZCO |
| **MAX6334**UR23D3-T | Open-Drain $\overline{\text{RESET}}$ | 2.30 | 100 | FZDO |
| MAX6334UR22D3-T | Open-Drain $\overline{\text{RESET}}$ | 2.20 | 100 | FZCV |
| MAX6334UR20D3-T | Open-Drain $\overline{\text{RESET}}$ | 2.00 | 100 | FZDN |
| MAX6334UR18D3-T | Open-Drain $\overline{\text{RESET}}$ | 1.80 | 100 | FZCU |
| MAX6334UR16D3-T | Open-Drain $\overline{\text{RESET}}$ | 1.60 | 100 | FZCT |

** Sample stock is generally held on all standard versions.*

# 3-Pin, Ultra-Low-Voltage, Low-Power µP Reset Circuits

## Chip Information

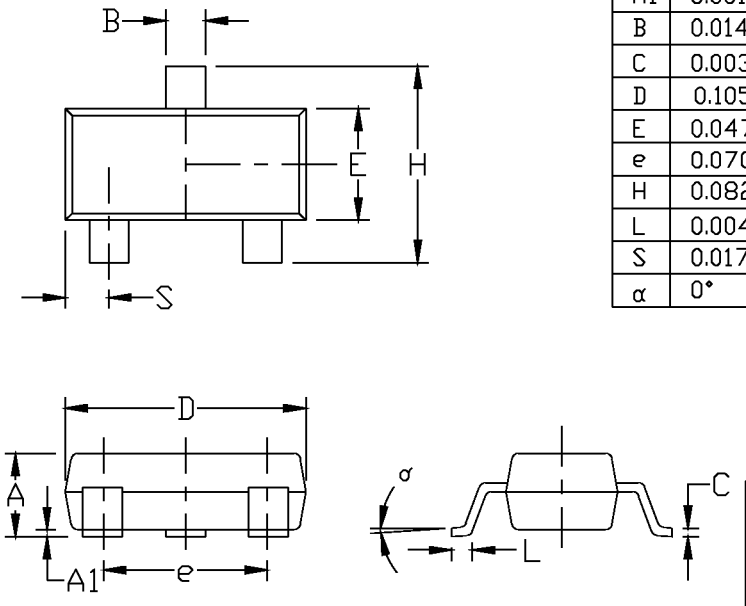
TRANSISTOR COUNT: 505

## Package Information

SOT03L.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. 21-0051 | REV C | 1/1