

## 300mA, Micropower, VLDO Linear Regulator

### UM365XXS SOT23-3

#### General Description

The UM365XXS series are VLDO (very low dropout) linear regulators designed for low power portable applications. Typical output noise is only  $100\mu\text{V}_{\text{RMS}}$  and maximum dropout is just 200mV at the load current of 100mA. The internal P-channel MOSFET pass transistor requires no base current, allowing the device to draw only  $90\mu\text{A}$  during normal operation at the maximum load current of 300mA.

Other features include high output voltage accuracy, excellent transient response, under voltage lockout, stability with ultralow ESR ceramic capacitors as small as  $1\mu\text{F}$ , thermal overload protection and output current limiting.

The UM365XXS series are available in a low profile SOT23-3 package.

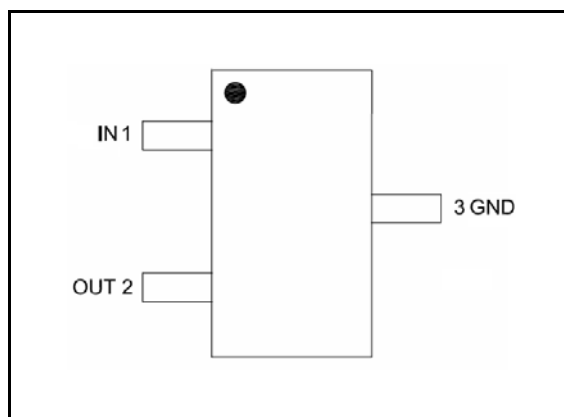
#### Applications

- Bluetooth/802.11 Cards
- PDAs and Notebook Computers
- Portable Instruments and Battery-Powered Systems
- Cellular Phones

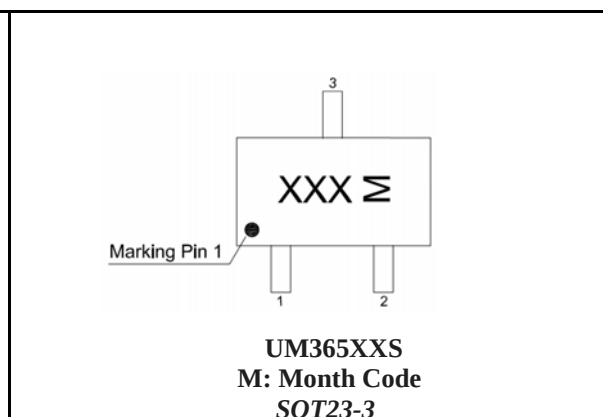
#### Features

- Low Dropout: 200mV(max) at 100mA
- Maximum Input Voltage: 6.0V
- Low Noise:  $100\mu\text{V}_{\text{RMS}}$  (10Hz to 100kHz)
- $\pm 2\%$  Voltage Accuracy at 150mA
- Fast Transient Response
- Fixed Output Voltage:  
5.0V/4.8V/4.7V/4.5V/4.3V/4.2V/4.0V/3.8V/  
3.6V/3.5V/3.3V/3.0V/2.8V/2.7V/2.5V/1.8V/  
1.5V/1.3V/1.2V
- Output Current Limit
- Stable with  $1\mu\text{F}$  Output Capacitor
- Thermal Overload Protection
- Low Profile SOT23-3 Package

#### Pin Configurations



#### Top View



**Pin Description**

| Pin Number | Symbol | Function                 |
|------------|--------|--------------------------|
| 1          | IN     | Power Supply             |
| 2          | OUT    | Voltage Regulated Output |
| 3          | GND    | Ground                   |

**Ordering Information**

| Part Number | Output Voltage | Packaging Type | Marking Code | Shipping Qty                 |
|-------------|----------------|----------------|--------------|------------------------------|
| UM36550S    | 5.0V           | SOT23-3        | U4F          | 3000pcs/7Inch<br>Tape & Reel |
| UM36548S    | 4.8V           |                | 54Q          |                              |
| UM36547S    | 4.7V           |                | 54P          |                              |
| UM36545S    | 4.5V           |                | 54J          |                              |
| UM36543S    | 4.3V           |                | U4E          |                              |
| UM36542S    | 4.2V           |                | U4D          |                              |
| UM36540S    | 4.0V           |                | 54R          |                              |
| UM36538S    | 3.8V           |                | 54K          |                              |
| UM36536S    | 3.6V           |                | 54L          |                              |
| UM36535S    | 3.5V           |                | 53Z          |                              |
| UM36533S    | 3.3V           |                | 53U          |                              |
| UM36530S    | 3.0V           |                | 52R          |                              |
| UM36528S    | 2.8V           |                | 52Q          |                              |
| UM36527S    | 2.7V           |                | 52P          |                              |
| UM36525S    | 2.5V           |                | 52N          |                              |
| UM36518S    | 1.8V           |                | 52K          |                              |
| UM36515S    | 1.5V           |                | 52J          |                              |
| UM36513S    | 1.3V           |                | 52E          |                              |
| UM36512S    | 1.2V           |                | 52D          |                              |

**Absolute Maximum Ratings (Note 1)**

| Symbol           | Parameter                                   | Value        | Unit |
|------------------|---------------------------------------------|--------------|------|
| V <sub>IN</sub>  | Supply Voltage on IN Pin                    | -7.5 to +7.5 | V    |
| V <sub>OUT</sub> | Voltage on OUT Pin                          | -0.3 to +7.5 | V    |
|                  | Output Short-Circuit Duration               | Indefinite   |      |
| T <sub>J</sub>   | Operating Junction Temperature (Notes 2, 3) | -40 to +125  | °C   |
| T <sub>STG</sub> | Storage Temperature Range                   | -65 to +150  | °C   |
| T <sub>L</sub>   | Lead Temperature for Soldering 10 seconds   | +300         | °C   |

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: The UM365XXS is tested and specified under pulse load conditions such that  $T_J \approx T_A$ . The device is guaranteed to meet performance specifications from 0 °C to 70 °C. Specifications over the – 40 °C to 125 °C operating junction temperature range are assured by design, characterization and correlation with statistical process controls.

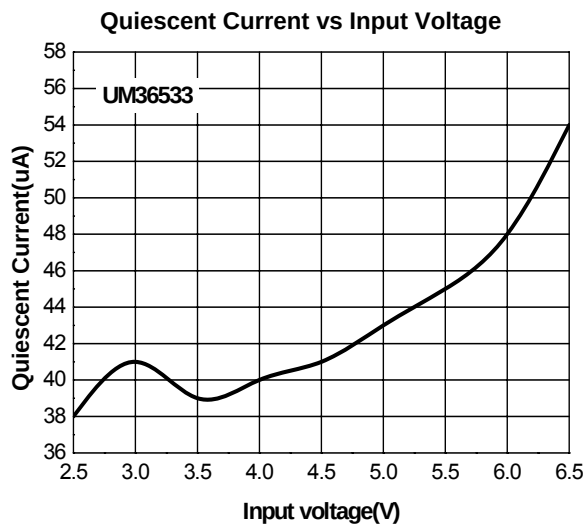
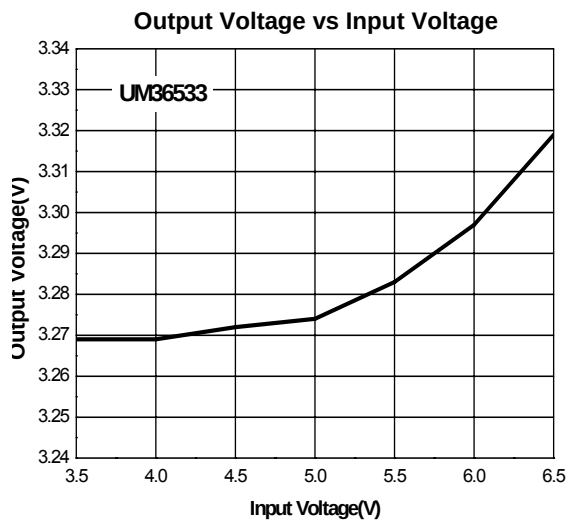
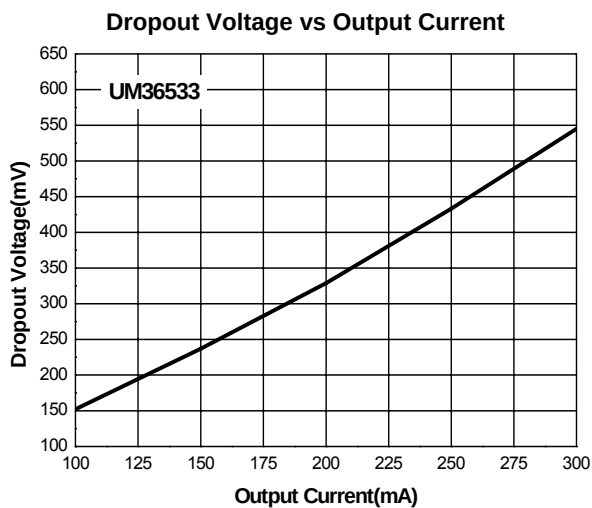
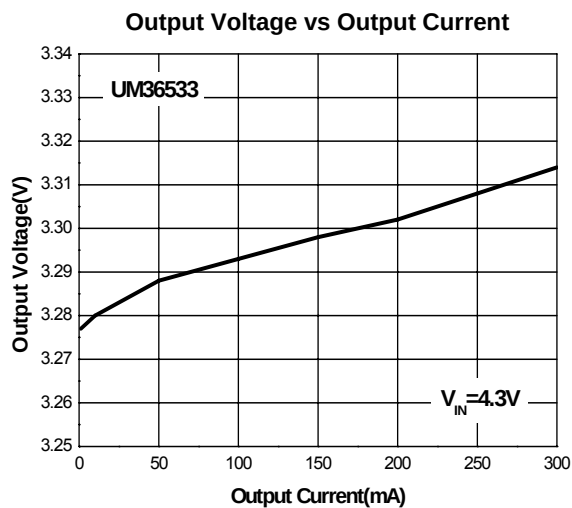
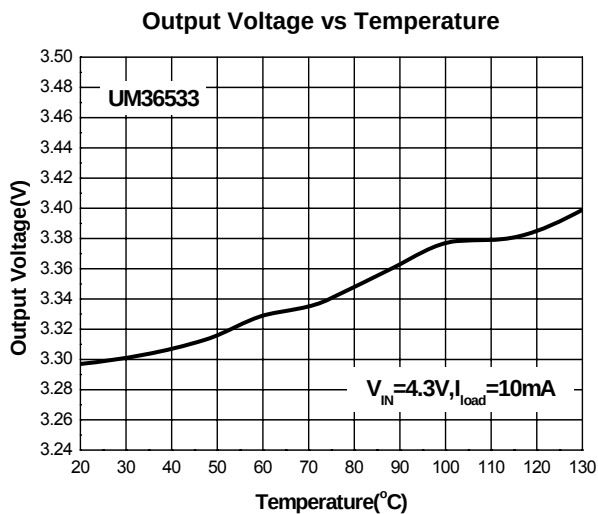
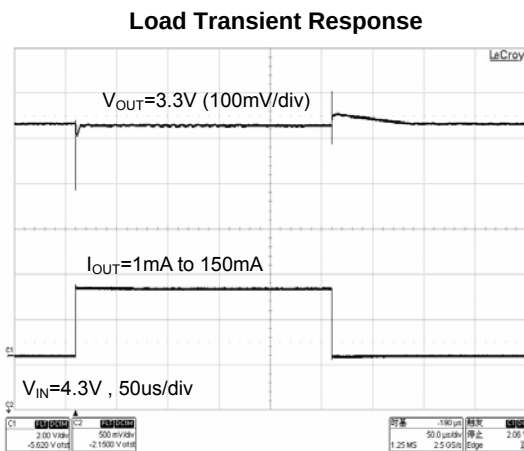
Note 3: This IC includes overtemperature protection that is intended to protect the device during momentary overload conditions. Junction temperature will exceed 125 °C when overtemperature protection is active. Continuous operation above the specified maximum operating junction temperature may impair device reliability.

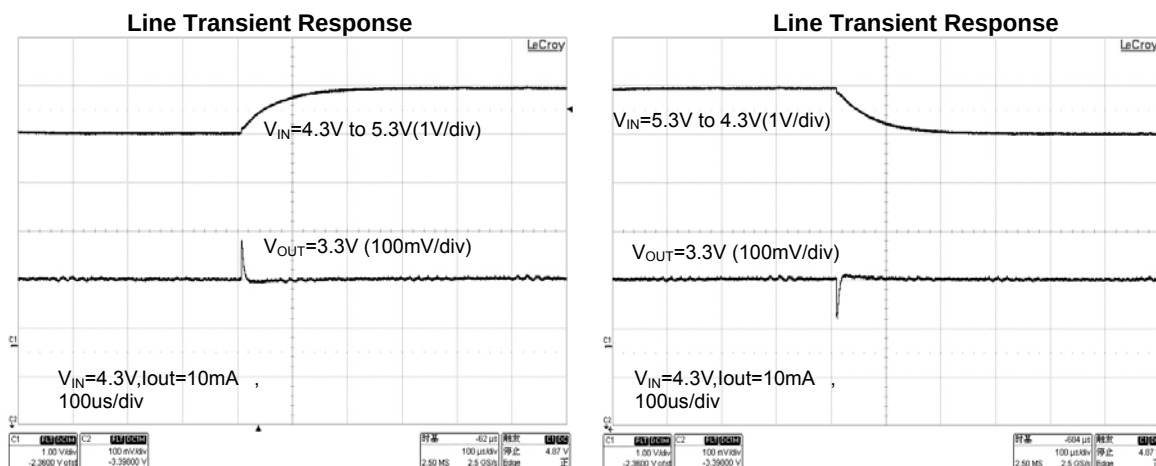
## Electrical Characteristics

$V_+ = +5 \pm 10\%$ ,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ . Typical conditions:  $V_{CC} = 5\text{V}$ ,  $T_A = 25^\circ\text{C}$ .

| Symbol            | Parameter                     | Test Conditions                                                                                              | Min     | Typ | Max  | Unit                     |
|-------------------|-------------------------------|--------------------------------------------------------------------------------------------------------------|---------|-----|------|--------------------------|
| $V_{IN}$          | Input Voltage Range           |                                                                                                              | 2.5     |     | 5.5  | V                        |
| $V_{OUT}$         | Output Voltage Range          |                                                                                                              | 1.2     |     | 5.0  | V                        |
| $I_Q$             | Operating Quiescent Current   | $I_{OUT} = 0\text{mA}$                                                                                       |         | 70  | 120  | $\mu\text{A}$            |
|                   |                               | $I_{OUT} = 300\text{mA}$                                                                                     |         | 90  | 130  |                          |
| $I_{OUT}$         | Output Current                |                                                                                                              | 300     |     |      | mA                       |
|                   | Output Voltage Accuracy       | $1\text{mA} \leq I_{OUT} \leq 300\text{mA}$ ,<br>$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$            | -2.5    |     | +2.5 | %                        |
| $\Delta V_{DO}$   | Dropout Voltage               | $I_{OUT} = 100\text{mA}$                                                                                     |         | 150 | 200  | mV                       |
| $I_{LIMIT}$       | Output Current Limit          | $R_L = 1\Omega$                                                                                              | 330     | 450 | 700  | mA                       |
| t                 | Startup Time Response         | $R_L = 68\Omega$ , $C_{OUT} = 1\mu\text{F}$                                                                  |         | 20  |      | $\mu\text{s}$            |
|                   | Output Voltage TC             |                                                                                                              |         | 100 |      | ppm/<br>$^\circ\text{C}$ |
| $T_{SHDN}$        | Thermal-Shutdown Temperature  |                                                                                                              |         | 160 |      | $^\circ\text{C}$         |
| $\Delta T_{SHDN}$ | Thermal-Shutdown Hysteresis   |                                                                                                              |         | 20  |      | $^\circ\text{C}$         |
|                   | Line Regulation               | $V_{OUT} + 0.3\text{V} \leq V_{IN} \leq 5.5\text{V}$ or<br>$V_{IN} > 2.5\text{V}$<br>$I_{OUT} = 10\text{mA}$ |         |     | 0.3  | %/V                      |
|                   | Load Regulation               | $V_{IN} = V_{OUT} + 1\text{V}$ or $V_{IN} > 2.5\text{V}$<br>$1\text{mA} \leq I_{OUT} \leq 300\text{mA}$      |         |     | 0.6  | %                        |
|                   | Output Voltage Noise          | 10Hz to 100KHz<br>$C_{IN} = 1\mu\text{F}$ , $I_{OUT} = 10\text{mA}$                                          |         | 100 |      | $\mu\text{V}_{RMS}$      |
| PSRR              | Power Supply Ripple Rejection | $V_{IN} = V_{OUT} + 1\text{V}$<br>$I_{OUT} = 100\text{mA}$                                                   | F=100Hz | 60  |      | dB                       |
|                   |                               |                                                                                                              | F=10KHz | 30  |      |                          |
|                   | ESD Rating                    | Human Body Mode                                                                                              | 2       |     |      | KV                       |

## Typical Performance Characteristics





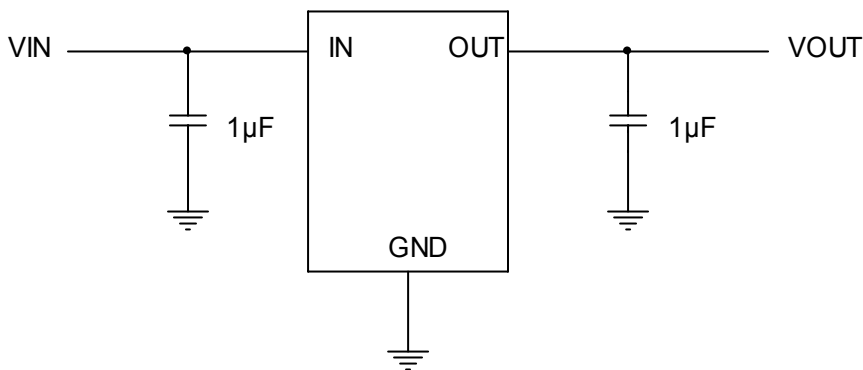
## Pin Function

**IN (Pin 1):** Power for UM365XXS and Load. Power is supplied to the devices through the IN pin. The IN pin should be locally bypassed to ground if the UM365XXS series are more than a few inches away from another source of bulk capacitance. In general, the output impedance of a battery rises with frequency, so it is usually advisable to include an input bypass capacitor in battery-powered circuits. A capacitor in the range of 0.1 $\mu$ F to 1 $\mu$ F is usually sufficient. The UM365XXS series are designed to withstand reverse voltages on the IN pin with respect to both ground and the output pin. In the case of a reversed input, which can happen if a battery is plugged in backwards, the UM365XXS will act as if there is a large resistor in series with its input with only a small amount of current flow.

**OUT (Pin 2):** Voltage Regulated Output. The OUT pin supplies power to the load. A minimum output capacitor of 1 $\mu$ F is required to ensure stability. Larger output capacitors may be required for applications with large transient loads to limit peak voltage transients. See the Applications Information section for more information on output capacitance.

**GND (Pin3):** Ground and Heat Sink. Solder to a ground plane or large pad to maximize heat dissipation.

## Typical Application Circuit



## Applications Information

The UM365XXS series are 300mA very low dropout regulators with micropower quiescent current. The maximum dropout is only 90mV at the load current of 150mA. Output voltage noise is as low as  $100\mu\text{V}_{\text{RMS}}$  over a 10Hz to 100kHz bandwidth.

In addition to the low quiescent current, the UM365XXS regulators incorporate several protection features which make them ideal for use in battery-powered systems. The devices are protected against both reverse input voltages and reverse voltages from output to input (reverse current protection). The devices also include current limit and thermal overload protection, and will survive an output short circuit indefinitely. The fast transient response over comes the traditional tradeoff between dropout voltage, quiescent current and load transient response inherent in most regulators by using a proprietary new architecture.

## Output Capacitance and Transient Response

The UM365XXS regulators are designed to be stable with a wide range of output capacitors. The ESR of the output capacitor affects stability, most notably with small capacitors. A minimum output capacitor of  $1\mu\text{F}$  with an ESR of  $0.3\Omega$  or less is recommended to ensure stability. The UM365XXS series are micropower devices and output transient response will be a function of output capacitance. Larger values of output capacitance decrease the peak deviations and provide improved transient response for larger load current changes. The shaded region of Figure 1 defines the region over which the UM365XXS regulators are stable. The maximum ESR allowed is  $0.3\Omega$ . High ESR tantalum and electrolytic capacitors may be used, but a low ESR ceramic capacitor must be in parallel at the output. There is no minimum ESR requirement.

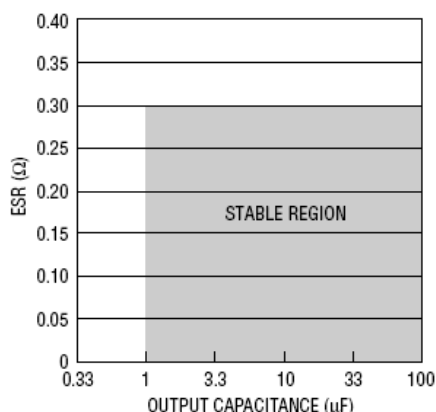


**Figure 1**

Extra consideration must be given to the use of ceramic capacitors. Ceramic capacitors are manufactured with a variety of dielectrics, each with different behavior across temperature and applied voltage. The most common dielectrics used are Z5U, Y5V, X5R and X7R. The Z5U and Y5V dielectrics are good for providing high capacitances in a small package, but exhibit strong voltage and temperature coefficients as shown in Figures 2 and 3. When used with a 5V regulator, a  $10\mu\text{F}$  Y5V capacitor can exhibit an effective value as low as  $1\mu\text{F}$  to  $2\mu\text{F}$  over the operating temperature range. The X5R and X7R dielectrics result in more stable characteristics and are more suitable for use as the output capacitor. The X7R type has better stability across temperature, while the X5R is less expensive and is available in higher values.

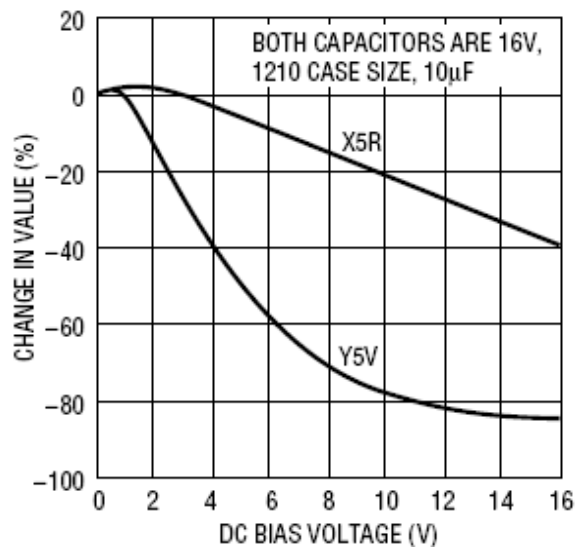


**Figure 2**

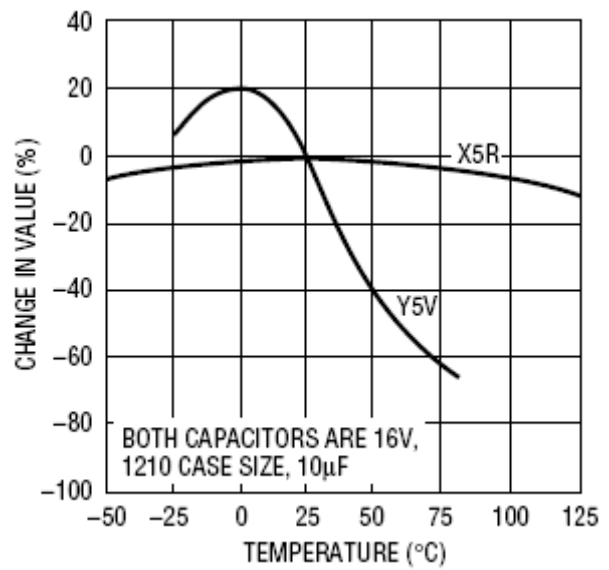


**Figure 3**

Additionally, some ceramic capacitors have a piezoelectric response. A piezoelectric device generates voltage across its terminals due to mechanical stress, similar to the way a piezoelectric accelerometer or microphone works. For a ceramic capacitor the stress can be induced by vibrations in the system or thermal transients. The resulting voltages produced can cause appreciable amounts of noise, especially when a ceramic capacitor is used for noise bypassing.

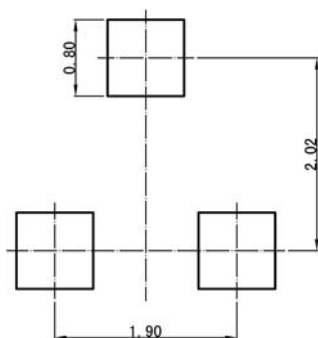
## Package Information

### UM365XXS: SOT23-3

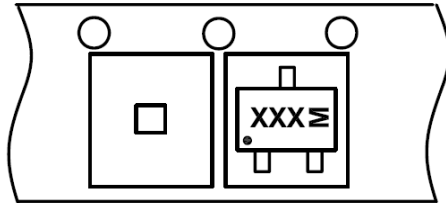
#### Outline Drawing

| DIMENSIONS |             |       |          |       |
|------------|-------------|-------|----------|-------|
| Symbol     | MILLIMETERS |       | INCHES   |       |
|            | Min         | Max   | Min      | Max   |
| A          | 1.050       | 1.250 | 0.041    | 0.049 |
| A1         | 0.000       | 0.100 | 0.000    | 0.004 |
| A2         | 1.050       | 1.150 | 0.041    | 0.045 |
| b          | 0.300       | 0.500 | 0.012    | 0.020 |
| c          | 0.100       | 0.200 | 0.004    | 0.008 |
| D          | 2.820       | 3.020 | 0.111    | 0.119 |
| E          | 1.500       | 1.700 | 0.059    | 0.067 |
| E1         | 2.650       | 2.950 | 0.104    | 0.116 |
| e          | 0.950REF    |       | 0.037REF |       |
| e1         | 1.800       | 2.000 | 0.071    | 0.079 |
| L          | 0.550REF    |       | 0.022REF |       |
| L1         | 0.300       | 0.600 | 0.012    | 0.024 |
| $\theta$   | 0°          | 8°    | 0°       | 8°    |

#### Land Pattern

|                                                                                     |                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>NOTES:</p> <ol style="list-style-type: none"> <li>1. Compound dimension: 2.92×1.60 ;</li> <li>2. Unit: mm;</li> <li>3. General tolerance <math>\pm 0.05\text{mm}</math> unless otherwise specified;</li> <li>4. The layout is just for reference.</li> </ol> |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

#### Tape and Reel Orientation

|                                                                                     |
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### IMPORTANT NOTICE

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