

RS7300

600mA Adjustable & Fixed Voltage LDO Linear Regulator

General Description

The RS7300 series is a low-dropout linear regulator that operates in the input voltage range from +2.4V to +7.0V and delivers 600mA output current.

The RS7300 is available in two types, fixed output voltage type and adjustable output voltage type. The fixed output voltage type is preset at an internally trimmed voltage 1.8V, 2.5V, or 3.3V. Other options 1.0V, 1.2V, 1.5V, 1.8V, 2.0V, 2.85V, 3.0V, 3.3V, 3.6V and 5.0V are available by special order only. The output voltage range of the adjustable type is from 1.25V to 5V.

The RS7300 (ADJ type) consists of a 1.25V bandgap reference, an error amplifier, and a P-channel pass transistor. Other features include short-circuit protection and thermal shutdown protection.

The RS7300 (Fixed type) consists of a 0.95V bandgap reference, an error amplifier, and a P-channel pass transistor. Other features include short-circuit protection and thermal shutdown protection. The RS7300 series devices are available in SOT-223, SOT-89 and SOT-23 packages.

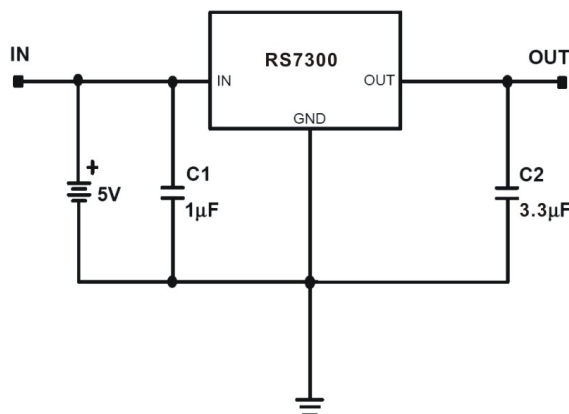
Features

- ⊙ Operating Voltage Range : +2.4V to +7.0V
- ⊙ Output Voltages : +1.0V to +5.0V (0.1V Step) (Fixed), +1.25V to +5.0V (ADJ Type)
- ⊙ Dropout Voltage : 500mV@600mA (Fixed)
- ⊙ Fast Response in Power-on (Fixed Voltage Only)
- ⊙ Low Current Consumption : 60μA (Typ.)
- ⊙ ±2% Output Voltage Accuracy (special ±1% highly accurate), $V_{OUT} \geq 1.8V$
- ⊙ Low ESR Capacitor Compatible
- ⊙ High Ripple Rejection : 55dB (Typ.)
- ⊙ Output Current Limit Protection : 1.0A (Typ.)
- ⊙ Short Circuit Protection : 200mA (Typ.)
- ⊙ Thermal Overload Shutdown Protection
- ⊙ SOT-223, SOT-89 and SOT-23 Packages
- ⊙ RoHS Compliant and 100% Lead (Pb)-Free and Green (Halogen Free with Commercial Standard)

Applications

- ⊙ Battery-Powered Equipments
- ⊙ Graphic Card, Peripheral Card
- ⊙ PCMCIA & New Card
- ⊙ Mini PCI & PCI-Express Cards
- ⊙ Digital Still Camera
- ⊙ CDMA/GSM Cellular Handsets
- ⊙ Laptop, Palmtops, Notebook Computers
- ⊙ Portable Information Application

Application Circuits



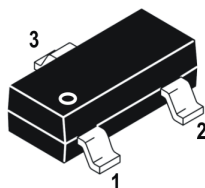


This integrated circuit can be damaged by ESD. Orister Corporation recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

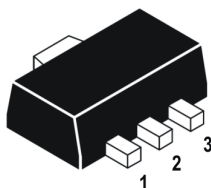
ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

Pin Assignments

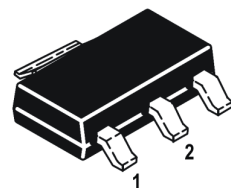
SOT-23



SOT-89



SOT-223



PACKAGE	PIN	SYMBOL	DESCRIPTION
SOT-23	1	VIN	Regulator Input Pin
	2	VOUT	Regulator Output Pin
	3	GND/ADJ	Ground Pin or ADJ Pin

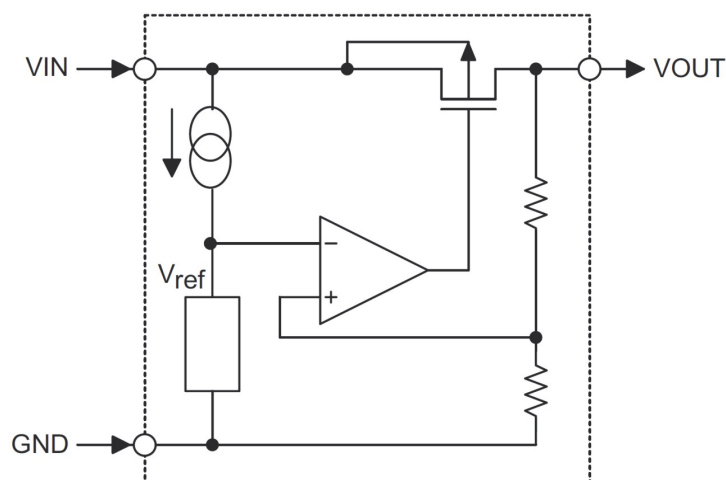
PACKAGE	PIN	SYMBOL	DESCRIPTION
SOT-89	1	GND/ADJ	Ground Pin or ADJ Pin
	2	VIN	Regulator Input Pin
	3	VOUT	Regulator Output Pin

PACKAGE	PIN	SYMBOL	DESCRIPTION
SOT-223	1	VOUT	Regulator Output Pin
	2	GND/ADJ	Ground Pin or ADJ Pin
	3	VIN	Regulator Input Pin

Ordering Information

DEVICE	DEVICE CODE
RS7300-XX YY Z	XX is nominal output voltage (for example, AD=ADJ, 15 = 1.5V, 33 = 3.3V, 285 = 2.85V). YY is package designator : N : SOT-23 M : SOT-89 SJ : SOT-223 Z is Lead Free designator : P: Commercial Standard, Lead (Pb) Free and Phosphorous (P) Free Package G: Green (Halogen Free with Commercial Standard)

Block Diagram



Absolute Maximum Ratings

Parameter		Symbol	Ratings	Units
Input Voltage V_{IN} to GND		V_{IN}	9.0	V
Output Current Limit, $I_{(LIMIT)}$		I_{LIMIT}	1.0	A
Junction Temperature		T_J	+155	°C
Thermal Resistance	SOT-89	θ_{JA}	180	°C/W
	SOT-223		155	
	SOT-23		260	
Power Dissipation	SOT-89	P_D	550	mW
	SOT-223		900	
	SOT-23		400	
Operating Ambient Temperature		T_{OPR}	-40 ~ +85	°C
Storage Temperature		T_{STG}	-55~+150	°C
Lead Temperature (soldering, 10sec)		-	+260	°C

NOTES :

- 1 The power dissipation values are based on the condition that junction temperature T_J and ambient temperature T_A difference is 100°C.
- 2 Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and function operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum –rated conditions for extended periods may affect device reliability.

Electrical Characteristics ($T_A=25^{\circ}\text{C}$, $V_{IN}=5.0\text{V}$ unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage	-	2.4	-	7.0	V
V_{OUT}	Output Voltage	Fixed Type	$V_{IN}=V_{OUT}+1.0\text{V}$, $I_{OUT}=1\text{mA}$, $V_{OUT} \geq 1.8\text{V}$	-2%	+2%	V
			$V_{IN}=V_{OUT}+1.0\text{V}$, $I_{OUT}=1\text{mA}$, $V_{OUT} < 1.8\text{V}$, $V_{IN} > 2.4\text{V}$	-35	+35	mV
		ADJ Type	$V_{IN}=V_{OUT}+1.2\text{V}$, $I_{OUT}=1\text{mA}$, $V_{OUT} \geq 1.8\text{V}$	-2%	+2%	V
			$V_{IN}=V_{OUT}+1.2\text{V}$, $I_{OUT}=1\text{mA}$, $V_{OUT} < 1.8\text{V}$, $V_{IN} > 2.4\text{V}$	-50	+50	mV
I_{MAX}	Output Current (see NOTE)	$V_{OUT}+1.0\text{V} \leq V_{IN} \leq 7.0\text{V}$, $V_{OUT} \geq 2.4\text{V}$	600	-	-	mA
V_{DROP}	Dropout Voltage (Fixed Type)	$I_{OUT}=100\text{mA}$, $V_{OUT}>3.0\text{V}$	-	100	-	mV
	Dropout Voltage (ADJ Type)	$I_{OUT}=600\text{mA}$, $V_{OUT}>3.0\text{V}$	-	500	-	
ΔV_{LINE}	Line Regulation	$V_{OUT}+1.0\text{V} \leq V_{IN} \leq 7\text{V}$, $I_{OUT}=1\text{mA}$ (Fixed Type)	-	0.2	0.3	%/V
		$V_{OUT}+1.2\text{V} \leq V_{IN} \leq 5\text{V}$, $I_{OUT}=1\text{mA}$, $V_{IN} \geq 2.8\text{V}$	-	-	0.2	
ΔV_{LOAD}	Load Regulation	$V_{IN}=V_{OUT}+1\text{V}$, $1\text{mA} \leq I_{OUT} \leq 600\text{mA}$	-	0.01	0.02	%/mA
I_Q	Ground Pin Current	$I_{LOAD}=0\text{mA}$ to 600mA , $V_{IN}=V_{OUT}+1.0\text{V}$	-	60	-	uA
I_{ADJ}	ADJ Pin Current	$I_{LOAD}=0\text{mA}$ to 600mA , $V_{IN}=V_{OUT}+1.0\text{V}$	-	60	-	uA
PSRR	Ripple Rejection	$I_{OUT}=30\text{mA}$, $F=1\text{KHz}$, $C_{OUT}=3.3\mu\text{F}$	-	55	-	dB
e_N	Output Noise	$I_{OUT}=100\text{mA}$, $F=1\text{KHz}$, $C_{OUT}=3.3\mu\text{F}$	-	40	-	$\mu\text{V}_{(rms)}$
T_{SD}	Thermal Shutdown Temperature	-	-	150	-	$^{\circ}\text{C}$
T_{HYS}	Thermal Shutdown Hysteresis	-	-	20	-	$^{\circ}\text{C}$

NOTE : Measured using a double sided board with 1" x 2" square inches of copper area connected to the GND pins for "heat spreading".

Detail Description

The RS7300 is a low-dropout linear regulator. The device provides preset 1.8V, 2.5V and 3.3V output voltages for output current up to 600mA. Adjustable output voltage and other mask options for special output voltages are also available. As illustrated in function block diagram, it consists of a 1.25V bandgap (Fixed voltage type is 0.95V) reference, an error amplifier, a P-channel pass transistor and an internal feedback voltage divider.

The bandgap reference for adjustable voltage type is connected to the error amplifier, which compares this reference with the feedback voltage and amplifies the voltage difference. If the feedback voltage is lower than the reference voltage, the pass transistor gate is pulled lower, which allows more current to pass to the output pin and increases the output voltage. If the feedback voltage is too high, the pass transistor gate is pulled up to decrease the output voltage.

The output voltage is feed back through an internal resistive divider (or external resistive divider for adjustable output voltage type) connected to V_{OUT} pin. Additional blocks include an output current limiter, thermal sensor, and shutdown logic.

Internal P-channel Pass Transistor

The RS7300 features a P-channel MOSFET pass transistor. Unlike similar designs using PNP pass transistors, P-channel MOSFETs require no base drive, which reduces quiescent current. PNP-based regulators also waste considerable current in dropout when the pass transistor saturates, and use high base-drive currents under large loads.

The RS7300 does not suffer from these problems and consumes only 60µA (Typ.) of current consumption under heavy loads as well as in dropout conditions.

Output Voltage Selection

For fixed voltage type of RS7300, the output voltage is preset at an internally trimmed voltage. The first two digits of part number suffix identify the output voltage (see Ordering Information). For example, the RS7300-33 has a preset 3.3V output voltage.

For adjustable voltage type of RS7300, the output voltage is set by comparing the feedback voltage at adjust terminal to the internal bandgap reference voltage. The reference voltage V_{REF} is 1.25V. The output voltage is given by the equation:

$$V_{OUT}=V_{REF} \times (1+R2/R1)+I_{ADJ} \times R2$$

Current Limit

The RS7300 also includes a fold back current limiter. It monitors and controls the pass transistor's gate voltage, estimates the output current, and limits the output current within 1.0A.

Thermal Overload Protection

Thermal overload protection limits total power dissipation in the RS7300. When the junction temperature exceeds T_J=+150°C, a thermal sensor turns off the pass transistor, allowing the IC to cool down. The thermal sensor turns the pass transistor on again after the junction temperature cools down by 20°C, resulting in a pulsed output during continuous thermal overload conditions.

Thermal overload protection is designed to protect the RS7300 in the event of fault conditions. For continuous operation, the absolute maximum operating junction temperature rating of T_J=+125°C should not be exceeded.

Operating Region and Power Dissipation

Maximum power dissipation of the RS7300 depends on the thermal resistance of the case and circuit board, the temperature difference between the die junction and ambient air, and the rate of airflow. The power dissipation across the devices is P = I_{OUT} × (V_{IN}-V_{OUT}). The resulting maximum power dissipation is:

$$P_{MAX} = \frac{(T_J - T_A)}{\theta_{JC} + \theta_{CA}} = \frac{(T_J - T_A)}{\theta_{JA}}$$

Where (T_J-T_A) is the temperature difference between the RS7300 die junction and the surrounding air, θ_{JC} is the thermal resistance of the package chosen, and θ_{CA} is the thermal resistance through the printed circuit board, copper traces and other materials to the surrounding air. For better heat-sinking, the copper area should be equally shared between the V_{IN}, V_{OUT}, and GND pins.

If the RS7300 uses a SOT-89 package and this package is mounted on a double sided printed circuit board with two square inches of copper allocated for “heat spreading”, the resulting θ_{JA} is 155°C/W.

Based on the maximum operating junction temperature 125°C with an ambient of 25°C, the maximum power dissipation will be:

$$P_{MAX} = \frac{(T_J - T_A)}{\theta_{JC} + \theta_{CA}} = \frac{(125 - 25)}{155} = 0.65W$$

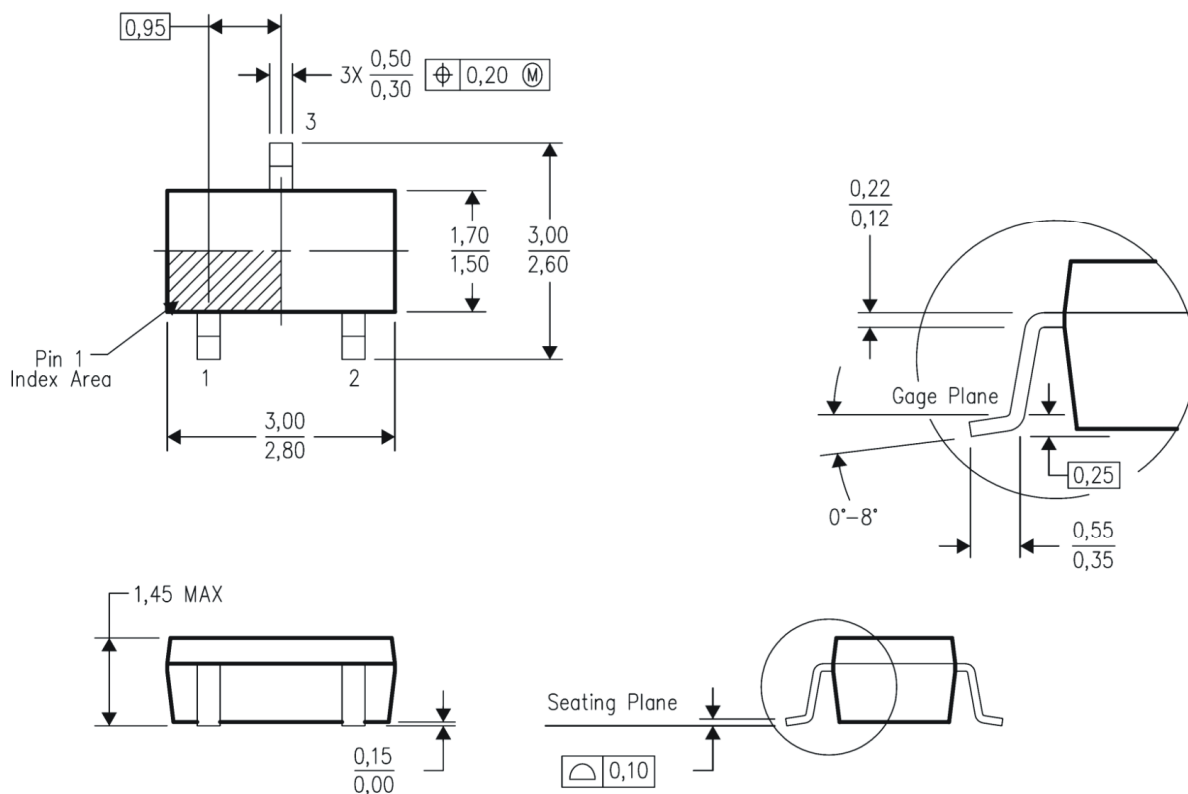
Thermal characteristics were measured using a double sided board with 1"x2" square inches of copper area connected to the GND pin for “heat spreading”.

Dropout Voltage

A regulator's minimum input-output voltage differential, or dropout voltage, determines the lowest usable supply voltage. In battery-powered systems, this will determine the useful end-of-life battery voltage. The RS7300 use a P-channel MOSFET pass transistor, its dropout voltage is a function of drain-to-source on-resistance $R_{DS(ON)}$ multiplied by the load current.

$$V_{DROPOUT} = V_{IN} - V_{OUT} = R_{DS(ON)} \times I_{OUT}$$

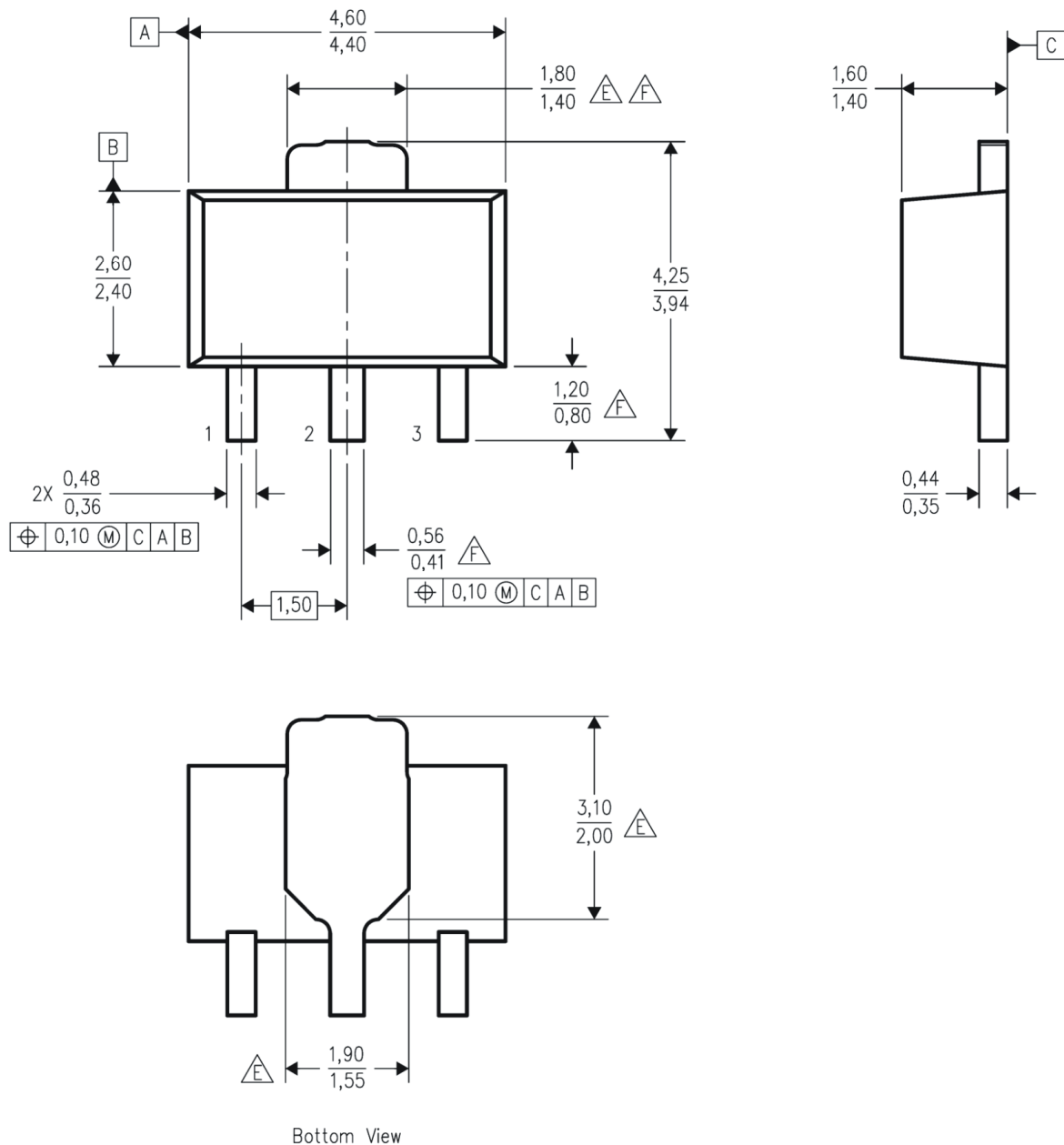
SOT-23 Dimension



NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.

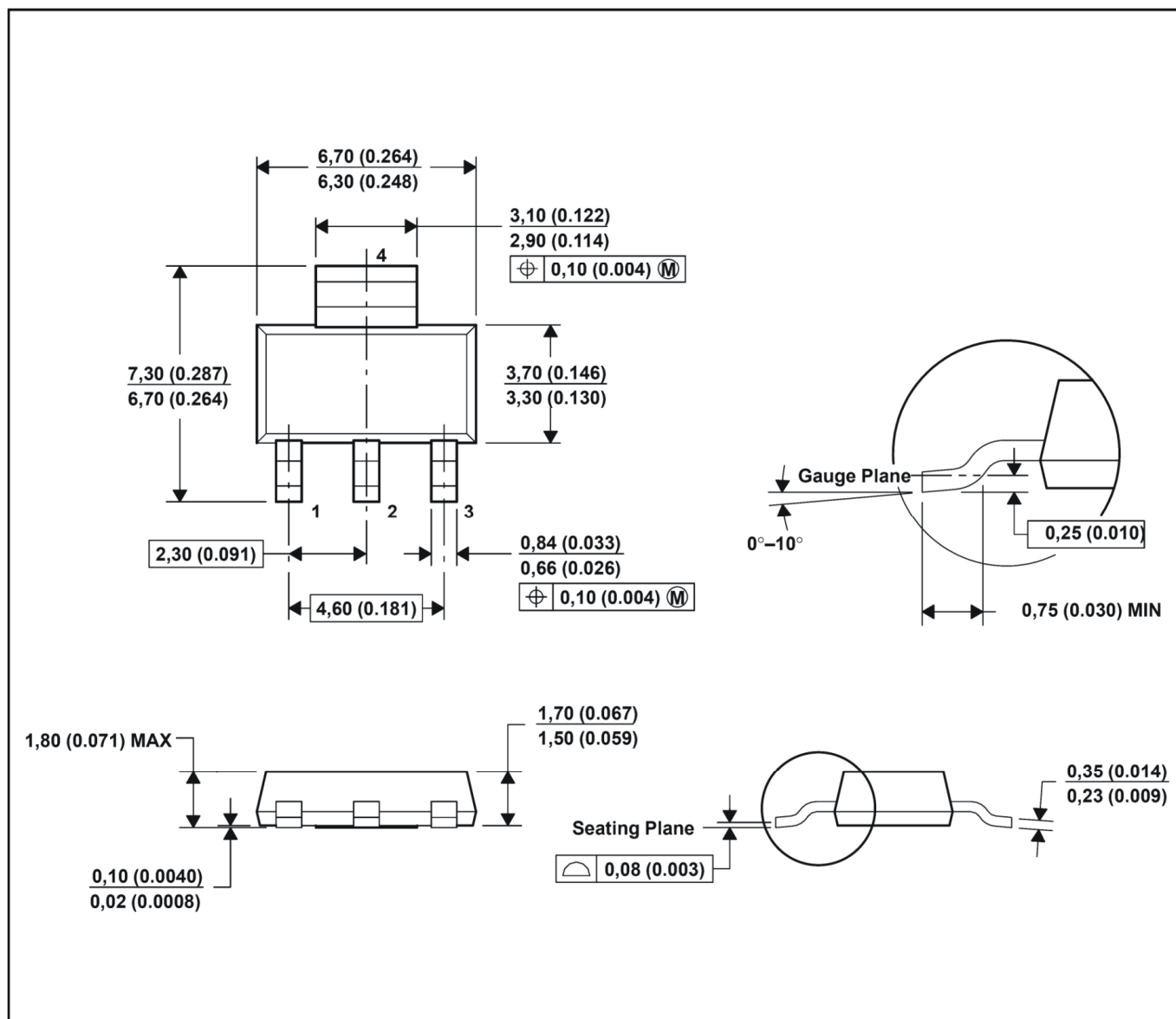
SOT-89 Dimension



NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- The center lead is in electrical contact with the tab.
- Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
- Thermal pad contour optional within these dimensions.
- Falls within JEDEC TO-243 variation AA, except minimum lead length, pin 2 minimum lead width, minimum tab width.

SOT-223 Dimension



NOTES:

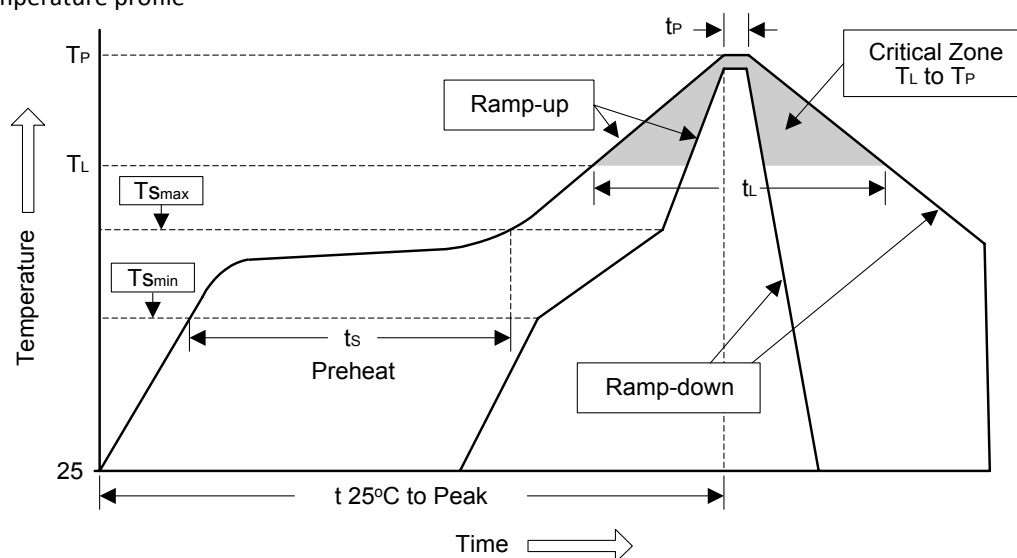
- All linear dimensions are in millimeters (inches).
- This drawing is subject to change without notice.
- Body dimensions do not include mold flash or protrusion.
- Falls within JEDEC TO-261 variation AA.

Soldering Methods for Orister's Products

1. Storage environment: Temperature=10°C~35°C Humidity=65%±15%

2. Reflow soldering of surface-mount devices

Figure 1: Temperature profile



Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T _L to T _P)	<3°C/sec	<3°C/sec
Preheat		
- Temperature Min (T _{smmin})	100°C	150°C
- Temperature Max (T _{smmax})	150°C	200°C
- Time (min to max) (ts)	60~120 sec	60~180 sec
T _{smmax} to T _L		
- Ramp-up Rate	<3°C/sec	<3°C/sec
Time maintained above:		
- Temperature (T _L)	183°C	217°C
- Time (t _L)	60~150 sec	60~150 sec
Peak Temperature (T _P)	240°C +0/-5°C	260°C +0/-5°C
Time within 5°C of actual Peak Temperature (t _p)	10~30 sec	20~40 sec
Ramp-down Rate	<6°C/sec	<6°C/sec
Time 25°C to Peak Temperature	<6 minutes	<8 minutes

3. Flow (wave) soldering (solder dipping)

Products	Peak temperature	Dipping time
Pb devices.	245°C ±5°C	5sec ±1sec
Pb-Free devices.	260°C +0/-5°C	5sec ±1sec

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