

RS7110

1.5A Fixed Voltage LDO Linear Regulator

General Description

The RS7110 series is a CMOS low-dropout linear regulator that operates in the input voltage range from +2.4V to +7.0V and delivers 1.5A output current.

The RS7110 is available fixed output voltage type is preset at an internally trimmed voltage 1.8V, 2.5V, or 3.3V. Other options 1.2V, 1.5V, 2.85V, 3.0V and 3.6V are available by special order only.

The RS7110 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 RS7110 series devices are available in SOT-223 and TO-252 packages.

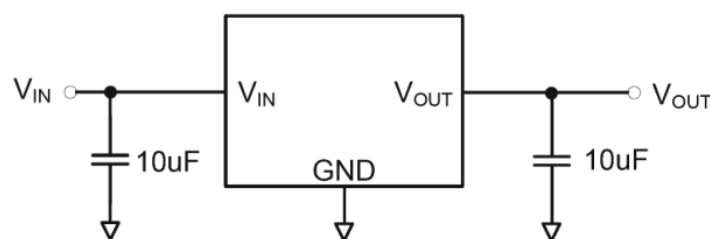
Features

- Operating Voltages Range : +2.5V to +7.0V
- Output Voltages Range : +1.0V to +5.0V with 100mV Increment
- Maximum Output Current : 1.5A
- Low Dropout: 800mV@1.5A (Typ.)
- 35 uS Fast Response when Power-on
- Low Current Consumption : 40µA (Typ.)
- ±2% Output Voltage Accuracy
- High Ripple Rejection : 55dB
- Output Current Limit Protection (2.0A)
- Short Circuit Protection (1.0A)
- Thermal Overload Shutdown Protection
- Low ESR Capacitor Compatible
- SOT-223 and TO-252 Packages
- RoHS Compliant and 100% Lead (Pb)-Free and Green (Halogen Free with Commercial Standard)

Applications

- Battery-powered equipment
- Active SCSI Terminators
- Low Voltage Micro-Controllers
- High Efficiency Linear Regulators
- Monitor Microprocessors
- Voltage regulator for microprocessor
- Voltage regulator for LAN cards
- Wireless Communication equipment
- Audio/Video equipment
- Post Regulator for Switching Power

Application Circuits

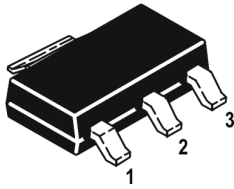


This integrated circuit can be damaged by ESD. Orister Corporation recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

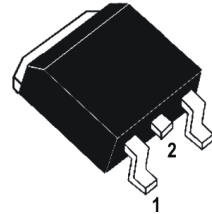
ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

Pin Assignments

SOT-223



TO-252



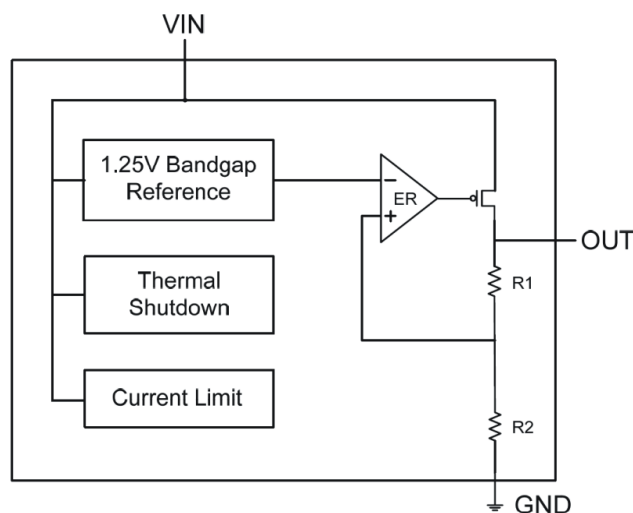
PACKAGE	PIN	SYMBOL	DESCRIPTION
SOT-223	1	VIN	Regulator Input Pin
	2	GND	Ground Pin
	3	VOUT	Regulator Output Pin

PACKAGE	PIN	SYMBOL	DESCRIPTION
TO-252	1	VIN	Regulator Input Pin
	2	GND	Ground Pin
	3	VOUT	Regulator Output Pin

Ordering Information

DEVICE	DEVICE CODE
RS7110-XX YY Z	<p>XX is nominal output voltage (for example, 15 = 1.5V, 33 = 3.3V, 285 = 2.85V). YY is package designator : SJ: SOT-223 J: TO-252 Z is Lead Free designator : P: Commercial Standard, Lead (Pb) Free and Phosphorous (P) Free Package G: Green (Halogen Free with Commercial Standard)</p>

Block Diagram



Absolute Maximum Ratings

Parameter		Symbol	Ratings	Units
Input Voltage VIN to GND		V _{IN}	9.0	V
Output Current Limit, I _(LIMIT)		I _{LIMIT}	2.0	A
Junction Temperature		T _J	+155	°C
Thermal Resistance	SOT-223	θ _{JA}	155	°C/W
	TO-252		90	
Power Dissipation	SOT-223	P _D	900	mW
	TO-252		1200	
Operating Ambient Temperature		T _{OPR}	-40 ~ +85	°C
Storage Temperature		T _{STG}	-55~+150	°C
Lead Temperature (soldering, 10sec)		-	+260	°C

NOTE: 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°C, unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V _{IN}	Input Voltage	-	2.4	-	7.0	V
V _{OUT}	Output Voltage	V _{IN} =V _{OUT} +1.0V, I _{OUT} =1mA, V _{OUT} ≥ 1.8V	-2%	V _{OUT}	+2%	V
		V _{IN} =V _{OUT} +1.0V, I _{OUT} =1mA, V _{OUT} < 1.8V, V _{IN} > 2.4V	-35		+35	mV
I _{MAX}	Output Current (see NOTE)	-	1.5	-	-	A
I _{LIMIT}	Current Limit	-	-	1.8	-	A
I _{SC}	Short Circuit Current	-	-	1.0	-	A
I _Q	Ground Pin Current	I _{LOAD} =0mA to 1.5A, V _{IN} = V _{OUT} +5.0V	-	40	65	uA
V _{DROP}	Dropout Voltage	I _{OUT} =100mA, V _{OUT} > 2.4V	-	30	45	mV
		I _{OUT} =500mA, V _{OUT} > 2.4V	-	230	350	
		I _{OUT} =900mA, V _{OUT} > 2.4V	-	500	750	
		I _{OUT} =1500mA, V _{OUT} > 2.4V	-	900	1350	
ΔV _{LINE}	Line Regulation	V _{OUT} +1.0V ≤ V _{IN} ≤ 7.0V, I _{OUT} =1mA For Fixed Voltage Type	-	0.2	0.3	%/V
ΔV _{LOAD}	Load Regulation	V _{IN} =V _{OUT} +1V, 1mA ≤ I _{OUT} ≤ 100mA	-	0.01	0.02	%/mA
e _N	Output Noise	I _{OUT} =100mA, F=1KHz, C _{OUT} =10uF	-	40	-	uV _(rms)
PSRR	Ripple Rejection	I _{OUT} =30mA, F=1KHz, C _{OUT} =10uF	-	55	-	dB
T _{SD}	Thermal Shutdown Temperature	-	-	160	-	°C
T _{HYS}	Thermal Shutdown Hysteresis	-	-	10	-	°C

NOTE : Measured using a double sided board with 1”x2” square inches of copper area connected to the GND pins for “heat spreading”.

Detail Description

The RS7110 is a CMOS low-dropout linear regulator. The device provides preset 1.8V, 2.5V and 3.3V output voltages for output current up to 1.5A. As illustrated in function block diagram, it consists of a 0.95V bandgap reference, an error amplifier, a P-channel pass transistor and an internal feedback voltage divider.

The bandgap reference voltage 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 connected to V_{OUT} pin. Additional blocks include an output current limiter, thermal sensor, and shutdown logic.

Internal P-channel Pass Transistor

The RS7110 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 RS7110 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 voltage type of RS7110, 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 RS7110-33 has a preset 3.3V output voltage.

Current Limit

The RS7110 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 2.0A (Typ.).

Thermal Overload Protection

Thermal overload protection limits total power dissipation in the RS7110. When the junction temperature exceeds T_J=+155°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 RS7110 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 RS7110 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 RS7110 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 IN, OUT, and GND pins.

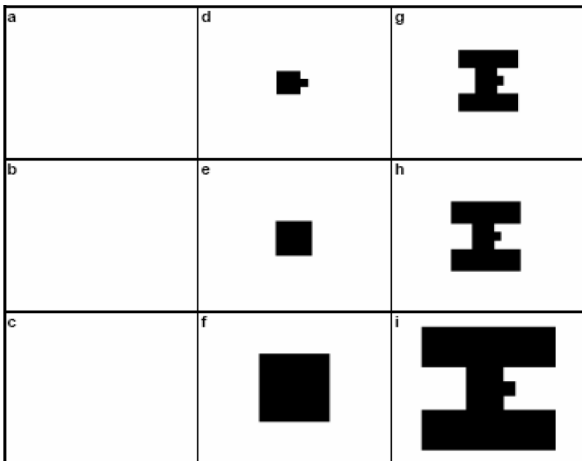
Dropout Voltage

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 RS7110 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.

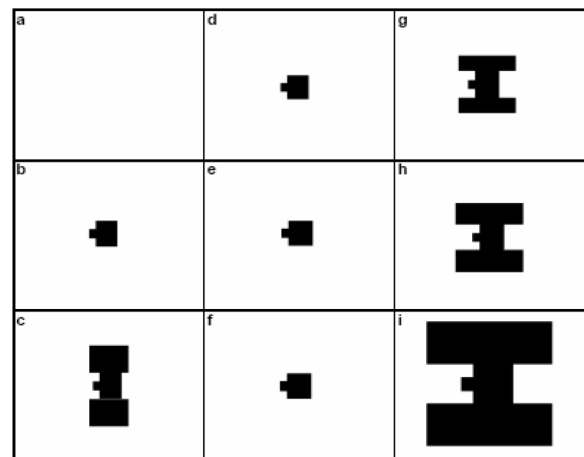
$$V_{DROPOUT} = V_{IN} - V_{OUT} = R_{DS(ON)} \times I_{OUT}$$

Application Note

Layout	Copper Area		Thermal Area	
	Top Side (in ²)	Bottom Side (in ²)	SOT-223 (θ_{JA} , °C/W)	TO-252 (θ_{JA} , °C/W)
a	0	0	140	106
b	0	0.070	127	91
c	0	0.310	84	64
d	0.067	0.067	125	89
e	0.200	0.080	118	87
f	0.600	0.080	89	63
g	0.285	0.285	92	64
h	0.393	0.393	78	58
i	0.500	0.500	73	55

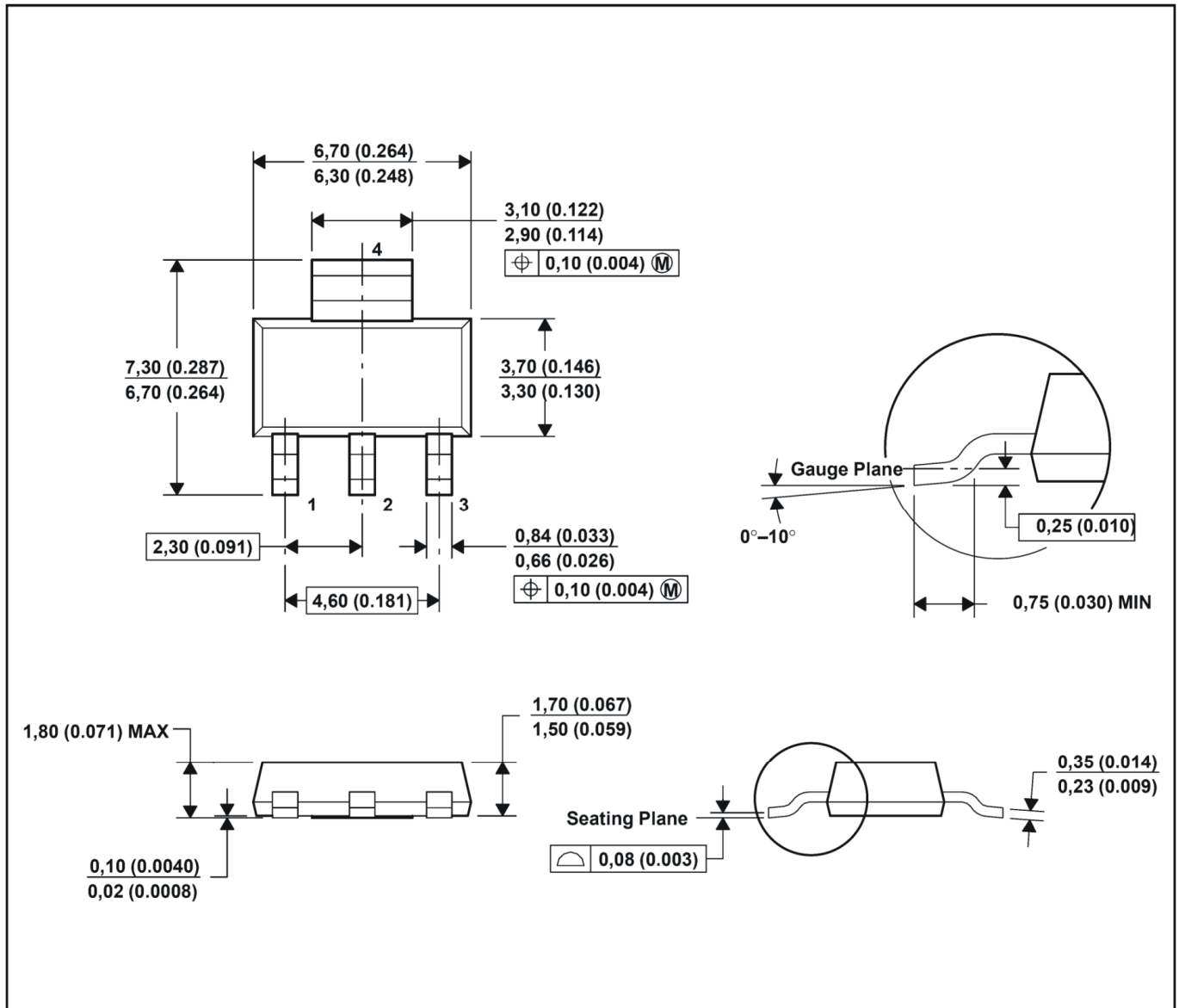


Top view of the PCB layout in real area.



Bottom view of the PCB layout in real area.

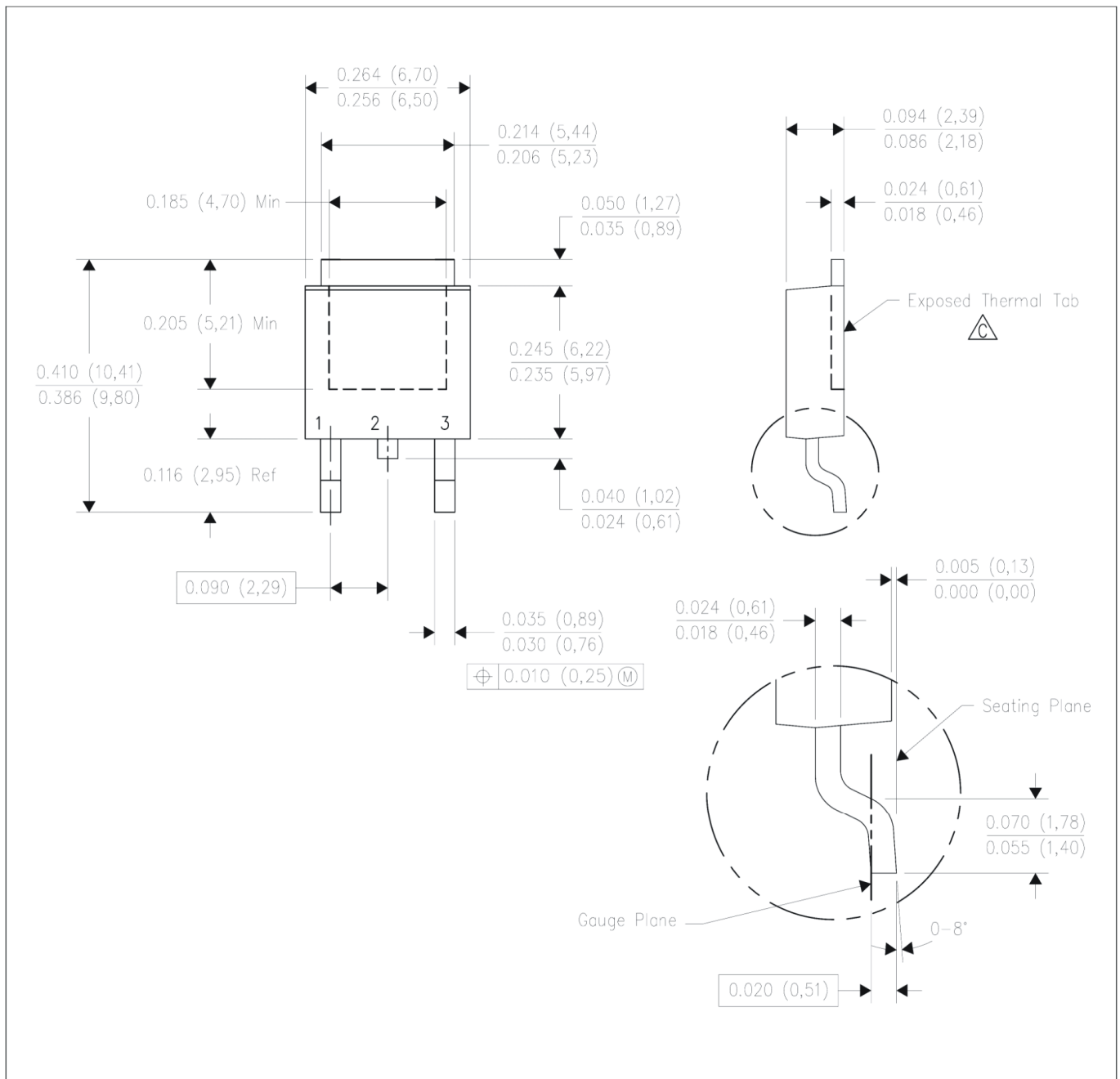
SOT-223 Dimension



NOTES:

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

TO-252 Dimension



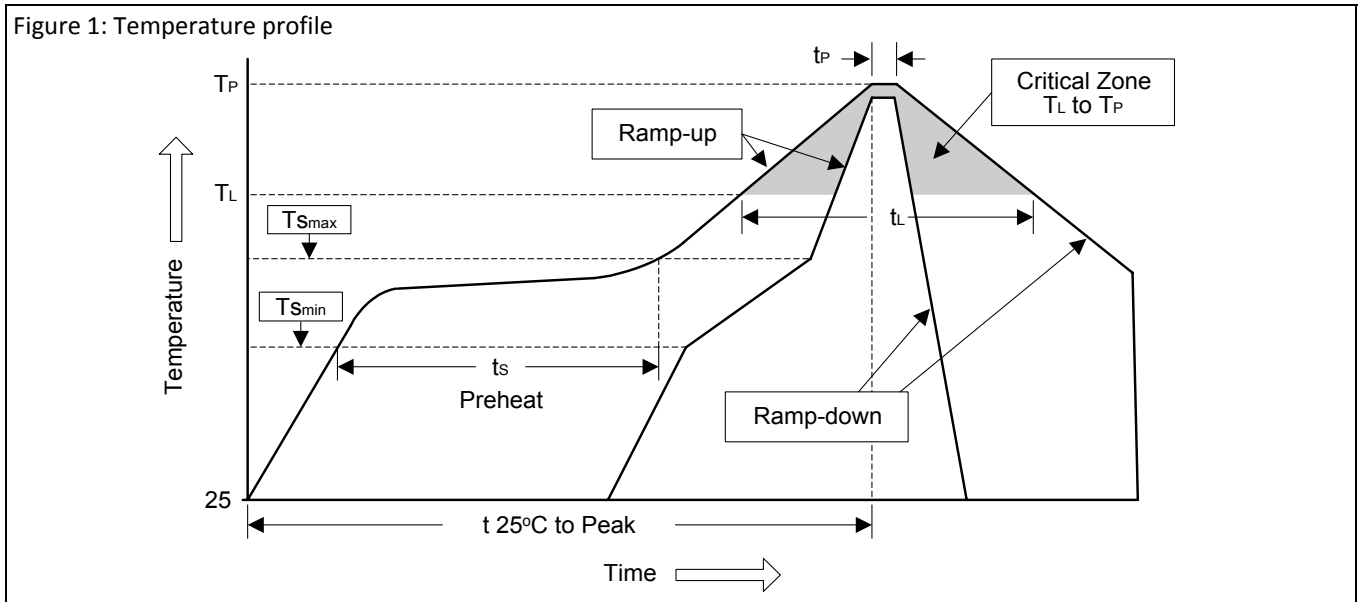
NOTES:

- All linear dimensions are in inches (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-252 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 _{Smin})	100°C	150°C
- Temperature Max (T _{Smax})	150°C	200°C
- Time (min to max) (ts)	60~120 sec	60~180 sec
T _{Smax} 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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