

RS7302

600mA Adjustable & Fixed Voltage LDO Linear Regulator with Enable, Fast Discharge & Soft-Start

General Description

The RS7302 series is a low-dropout linear regulator with ON/OFF control that operates in the input voltage range from +2.4V to +7.0V and delivers 600mA output current.

The RS7302 is available 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, 2.85V, 3.0V and 3.6V are available by special order only.

The RS7302 series consists of a 0.95V bandgap reference, an error amplifier, and a P-channel pass transistor. Other features include soft-start function, short-circuit protection and thermal shutdown protection. The RS7302 series devices are available in SOT-25, SC-70-5 & SOP-8 packages.

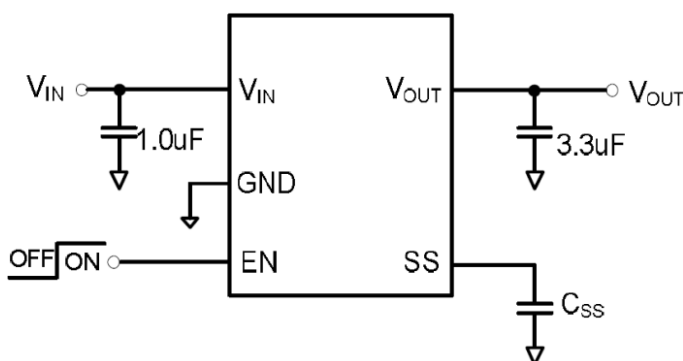
Features

- ⊙ Operating Voltage Range : +2.4V to +7.0V
- ⊙ Output Voltages : +1.0V to +5.0V (0.1V Step), +1.25V to +5.0V
- ⊙ Dropout Voltage : 500mV@600mA (Fixed)
- ⊙ Fast Response in Power-on : 35µs
- ⊙ Low Current Consumption : 60µA (Typ.)
- ⊙ Low ESR Capacitor Compatible
- ⊙ High Ripple Rejection : 65dB (Typ.)
- ⊙ Short Circuit Protection : 200mA (Typ.)
- ⊙ Thermal Overload Shutdown Protection
- ⊙ SOT-25, SC-70-5 and SOP-8 packages
- ⊙ RoHS Compliant and 100% Lead (Pb)-Free and Green (Halogen Free with Commercial Standard)

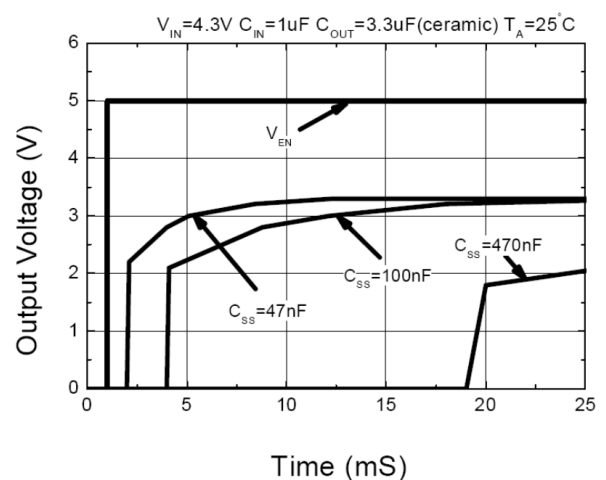
Applications

- ⊙ 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



Soft-Start Function

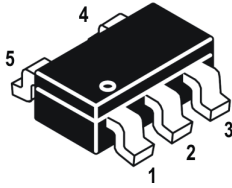


This integrated circuit can be damaged by ESD. Orister Corporation recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

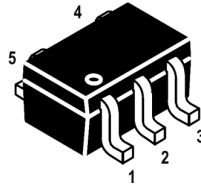
ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

Pin Assignments

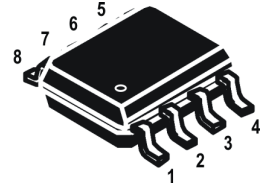
SOT-25



SC-70-5



SOP-8



PACKAGE	PIN	SYMBOL	DESCRIPTION
SOT-25	1	VIN	Regulator Input Pin
	2	GND	Ground Pin or ADJ Pin
	3	EN	Enable Pin
	4	SS	Soft-Start Pin
	5	VOUT	Regulator Output Pin

PACKAGE	PIN	SYMBOL	DESCRIPTION
SC-70-5	1	VIN	Regulator Input Pin
	2	GND	Ground Pin or ADJ Pin
	3	EN	Enable Pin
	4	SS	Soft-Start Pin
	5	VOUT	Regulator Output Pin

PACKAGE	PIN	SYMBOL	DESCRIPTION
SOP-8	1	EN	Enable Pin
	2	VIN	Regulator Input Pin
	3	VOUT	Regulator Output Pin
	4	SS	Soft-Start Pin
	5, 6, 7, 8	GND	Ground Pin or ADJ Pin

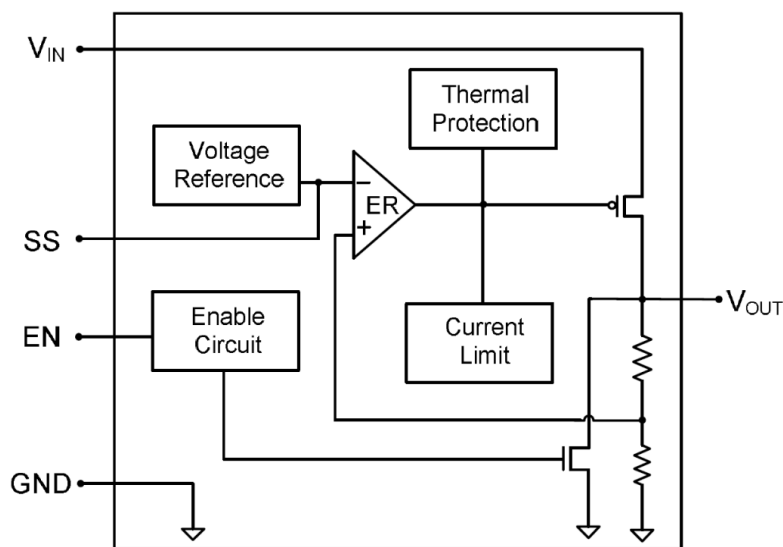
Ordering Information

DEVICE	DEVICE CODE
RS7302-XX EEE YY Z	<p>XX is nominal output voltage (for example, AD=ADJ, 18 = 1.8V, 33 = 3.3V, 285 = 2.85V).</p> <p>EEE is CE Input Logic & Discharge Function Selection : (see CE & Discharge Function Selection Table)</p> <p>YY is package designator :</p> <p>NE : SOT-25 SC : SC-70-5 S : SOP-8</p> <p>Z is Lead Free designator :</p> <p>P: Commercial Standard, Lead (Pb) Free and Phosphorous (P) Free Package G: Green (Halogen Free with Commercial Standard)</p>

CE & Discharge Function Selection Table

EEE CODE	EN Type		Discharge	EEE CODE	EN Type		Discharge
	Type 1	Type 2			Type 1	Type 2	
NHF	None	High Active	Fast	UHN	Pull High	High Active	Normal
NLF	None	Low Active	Fast	ULN	Pull High	Low Active	Normal
NHN	None	High Active	Normal	DHF	Pull Low	High Active	Fast
NLN	None	Low Active	Normal	DLF	Pull Low	Low Active	Fast
UHF	Pull High	High Active	Fast	DHN	Pull Low	High Active	Normal
ULF	Pull High	Low Active	Fast	DLN	Pull Low	Low Active	Normal

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	θ_{JA}	SOT-25	155
		SC-70-5	333
		SOP-8	60
Power Dissipation	P_D	SOT-25	350
		SC-70-5	250
		SOP-8	1670
Operating Ambient Temperature	T_{OPR}	-40 ~ +85	°C
Storage Temperature	T_{STG}	-55 ~ +150	°C
Lead Temperature (soldering, 10sec)	-	+260	°C

NOTES :

- The power dissipation values are based on the condition that junction temperature T_J and ambient temperature T_A difference is 100°C.
- 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
		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
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	$I_{OUT}=100\text{mA}$, $V_{OUT}>3.0\text{V}$	-	100	-	mV
		$I_{OUT}=600\text{mA}$, $V_{OUT}>3.0\text{V}$	-	500	-	
ΔV_{LINE}	Line Regulation	$V_{OUT}+1.0\text{V}\leq V_{IN}\leq 7\text{V}$, $I_{OUT}=1\text{mA}$	-	0.2	0.3	%/V
ΔV_{LOAD}	Load Regulation	$V_{IN}=V_{OUT}+1\text{V}$, $1\text{mA}\leq I_{OUT}\leq 100\text{mA}$	-	0.01	0.02	%/mA
I_Q	Ground Pin Current	$I_{LOAD}=0\text{mA}$ to 1.0A , $V_{IN}=V_{OUT}+1.0\text{V}$	-	60	-	uA
I_{SD}	Shutdown Current	$V_{IN}=V_{OUT}+1\text{V}$, $EN=0\text{V}$, No Load	-	0.7	-	uA
I_{SC}	Short Circuit Current	-	-	250	-	mA
PSRR	Ripple Rejection	$I_{OUT}=30\text{mA}$, $F=1\text{KHz}$, $C_{OUT}=3.3\mu\text{F}$	-	65	-	dB
e_N	Output Noise	$I_{OUT}=100\text{mA}$, $F=1\text{KHz}$, $C_{OUT}=3.3\mu\text{F}$	-	40	-	$\mu\text{V}_{(rms)}$
V_{IH}	EN Pin Input Voltage "H"	$V_{IN}\leq 5.0\text{V}$	1.6	-	-	V
V_{IL}	EN Pin Input Voltage "L"	$V_{IN}\leq 5.0\text{V}$	-	-	0.3	V
R_{DIS}	Discharge Resistor	$V_{EN}=0\text{V}$, For Fixed Voltage Type	-	30	100	Ω
T_{DIS}	Discharge Time	$V_{OUT}=3.3\text{V}$ to 0V , $C_{OUT}=1\mu\text{F}$, For Fixed Voltage Type	-	70	100	us
T_{SS}	Soft-Start Time	$V_{OUT}=3.3\text{V}$, $C_{SS}=47\text{nF}$, $C_{IN}=C_{OUT}=1\mu\text{F}$	-	10	-	ms
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 RS7302 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. Other mask options for special output voltages are also available. 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 0.95V bandgap reference 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 feedback 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 RS7302 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 RS7302 does not suffer from these problems and consumes only 60 μ A (Typ.) of current consumption under heavy loads as well as in dropout conditions.

Enable Function

EN pin starts and stops the regulator. When the EN pin is switched to the power off level, the operation of all internal circuit stops, the build-in P-channel MOSFET output transistor between pins V_{IN} and V_{OUT} is switched off, allowing current consumption to be drastically reduced. The V_{OUT} pin enters the GND level through the internal discharge path between V_{OUT} and GND pins.

Soft Start Function

The capacitor can be connected between the BYPASS pin and GND. This capacitor can be a low cost Polyester Film variety. A larger capacitor improves the AC ripple rejection, but also makes the output come up slowly. This "Soft" turn-on is desirable in some applications to limit turn-on surges.

Fast Discharge Function

The RS7302 fixed type has fast discharge Function on EN pin disable. When user turns off the device, its internal pull-low resistor will discharge output capacitor charge. It'll avoid other device to arise wrong motions.

Output Voltage Selection

For fixed voltage type of RS7302, 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 RS7302-33 has a preset 3.3V output voltage.

Current Limit

The RS7302 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 (Typ.)

Thermal Overload Protection

Thermal overload protection limits total power dissipation in the RS7302. When the junction temperature exceeds $T_J=+165^{\circ}\text{C}$, 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 $^{\circ}\text{C}$, resulting in a pulsed output during continuous thermal overload conditions.

Thermal overload protection is designed to protect the RS7302 in the event of fault conditions. For continuous operation, the absolute maximum operating junction temperature rating of $T_J=+125^{\circ}\text{C}$ should not be exceeded.

Operating Region and Power Dissipation

Maximum power dissipation of the RS7302 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 $P=I_{OUT} \times (V_{IN}-V_{OUT})$. The resulting maximum power dissipation is:

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

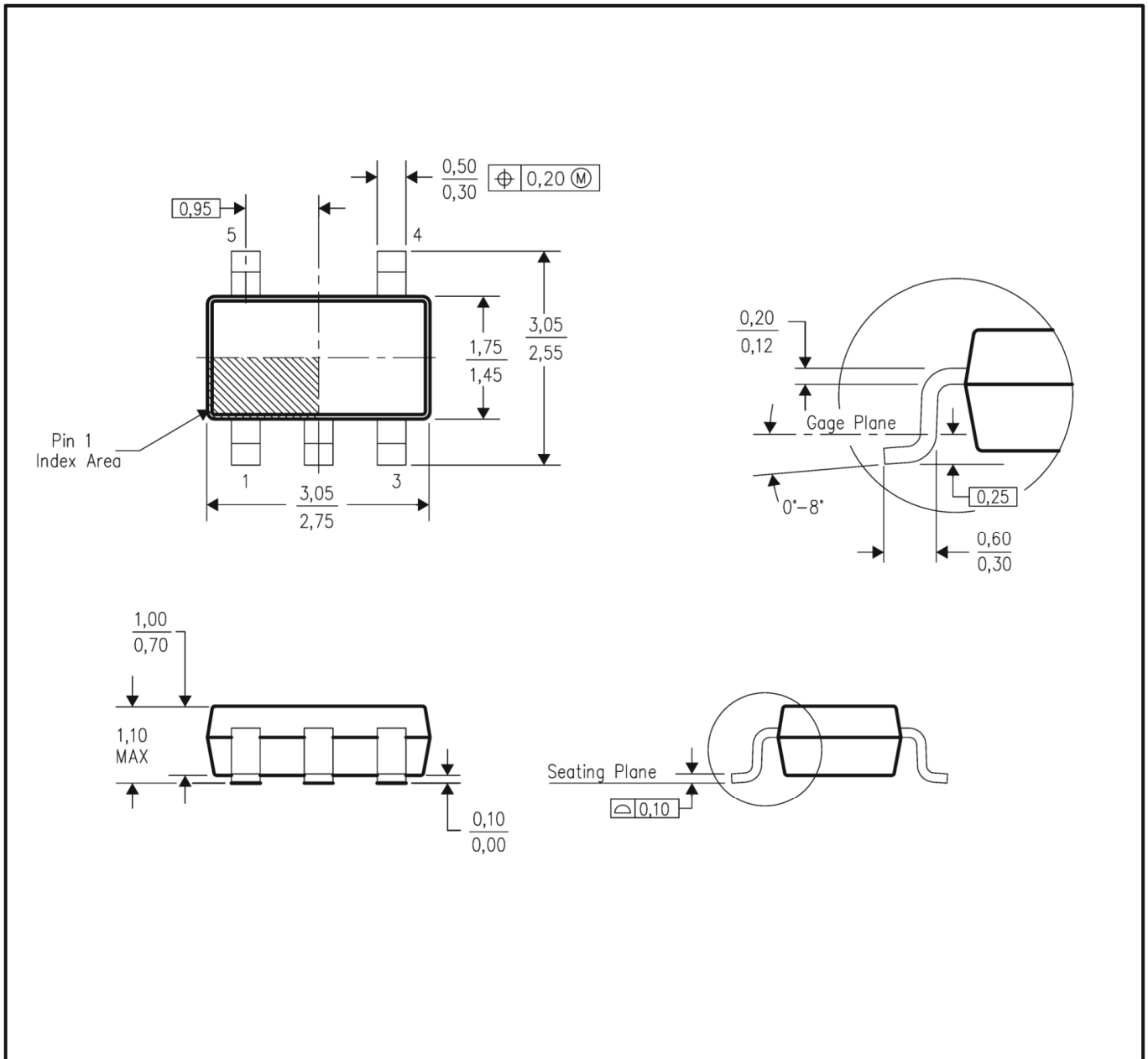
Where (T_J-T_A) is the temperature difference between the RS7301 die junction and the surrounding air, θ_{JC} is the thermal resistance of the package chosen, and θ_{CA} is the thermal resistance through the printed circuit board, copper traces and other materials to the surrounding air. For better heat-sinking, the copper area should be equally shared between the V_{IN} , V_{OUT} , and GND pins.

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 RS7302 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.

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

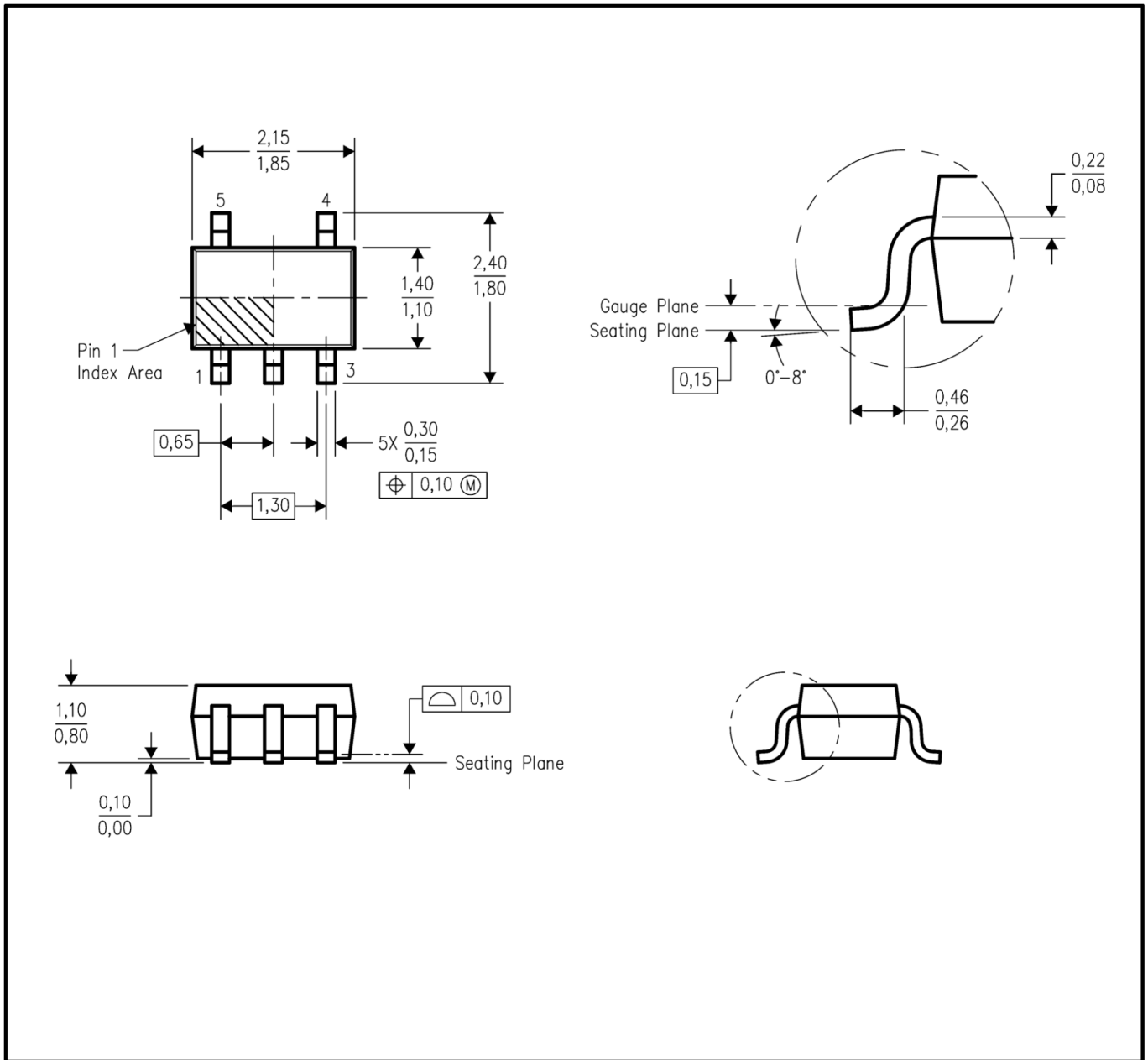
SOT-25 Dimension



NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- Body dimensions do not include mold flash or protrusion.
- Falls within JEDEC MO-193 variation AB (5 pin).

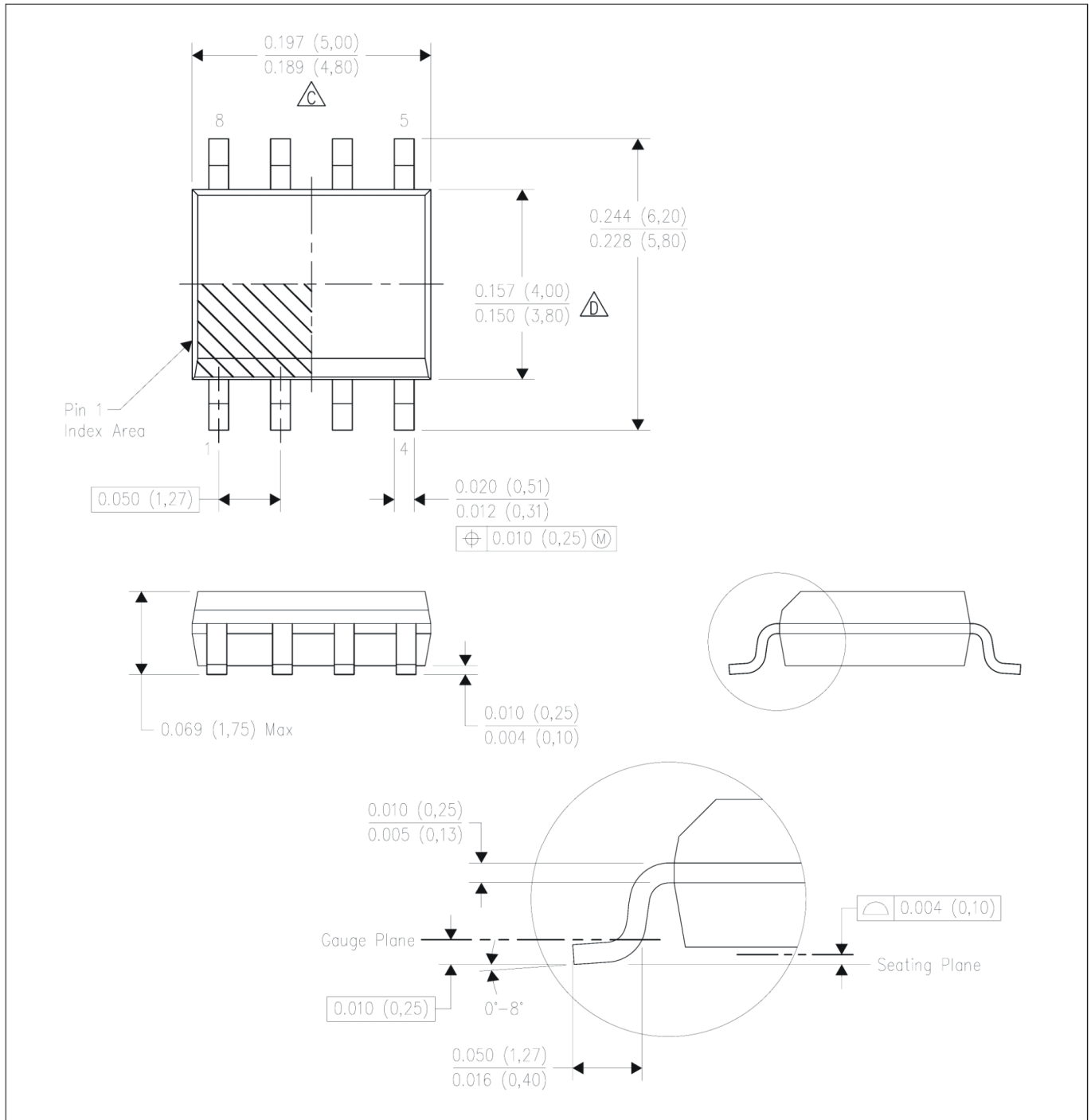
SC-70-5 Dimension



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.
- Falls within JEDEC MO-203 variation AA.

SOP-8 Dimension



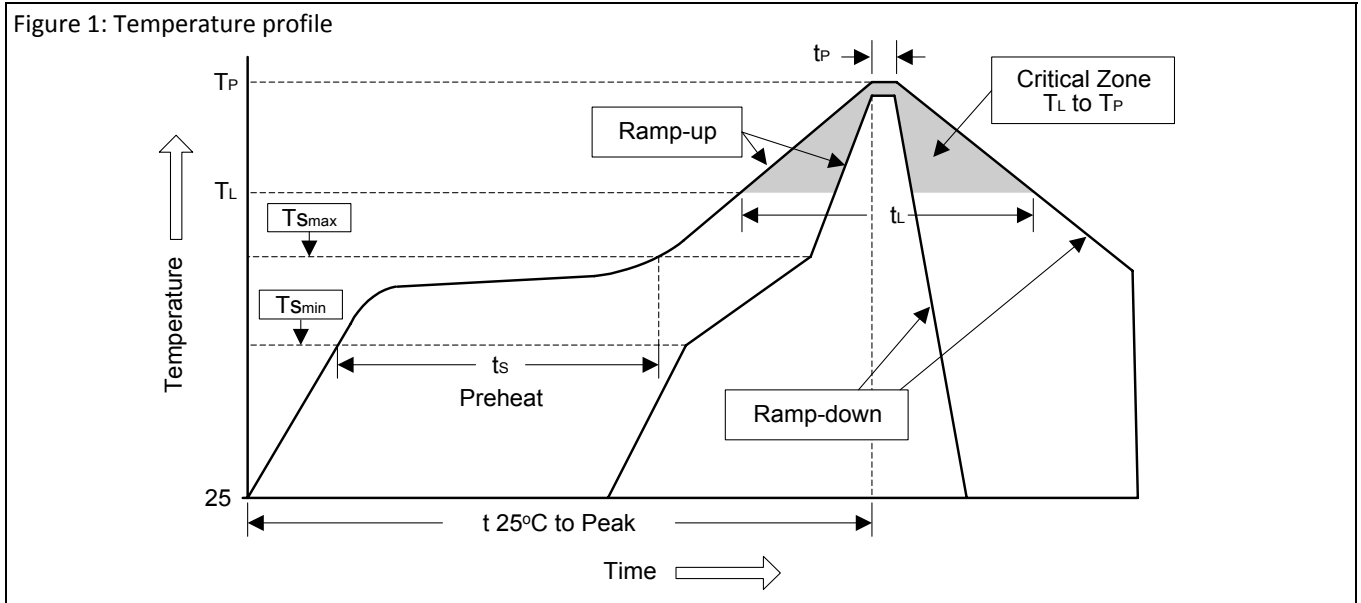
NOTES:

- All linear dimensions are in millimeters (inches).
- This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0.15) per end.
- Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0.43) per side.
- Falls within JEDEC MS-012 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) (t_s)	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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