RS7103

Low Power 300mA CMOS LDO with Enable

General Description

The RS7103 is a low-dropout linear regulator that operates in the input voltage range from +2.5V to +9.0V and delivers 300mA output current.

The high-accuracy output voltage is preset at an internally trimmed voltage 2.5V or 3.3V. Other output voltages can be mask-optioned from 1.5V to 5.0V with 100mV increment.

The RS7103 consists of a 1.25V reference, an error amplifier, a P-channel pass transistor, and an enable/disable logic circuit. Other features include short-circuit protection, soft start function, and thermal shutdown protection. The RS7103 device is available in SOT-25 package.

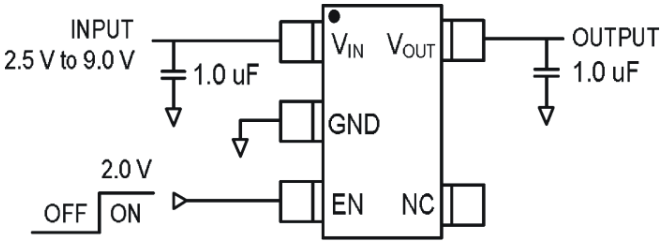
Features

- Operating Voltages Range：+2.5V to +9.0V
- Output Voltages Range：+1.5V to +5.0V with 100mV Increment
- Maximum Output Current：300mA
- Low Dropout: 400mV@300mA (Typ.)
- ±2% Output Voltage Accuracy
- High Ripple Rejection：60dB
- Output Current Limit Protection (500mA)
- Short Circuit Protection (260mA)
- Thermal Overload Shutdown Protection
- Low ESR Capacitor Compatible
- Control Output ON/OFF function
- SOT-25 Packages
- RoHS Compliant and 100% Lead (Pb)-Freeand Green (Halogen Free with Commercial Standard)

Applications

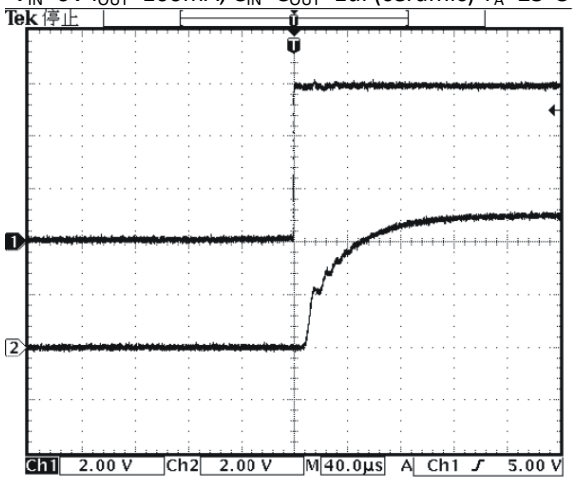
- Battery-powered equipment
- Voltage regulator for microprocessor
- Voltage regulator for LAN cards
- Wireless Communication equipment
- Audio/Video equipment
- Post Regulator for Switching Power
- Home Electric/Electronic Appliance

Application Circuits



Soft-Start Function

V_{IN}=6V I_{OUT}=100mA, C_{IN}=C_{OUT}=1uF(ceramic) T_A=25°C

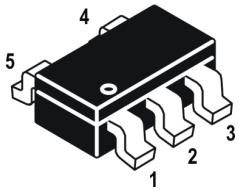


This integrated circuit can be damaged by ESD. Orister Corporation recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

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 Assignment

SOT-25

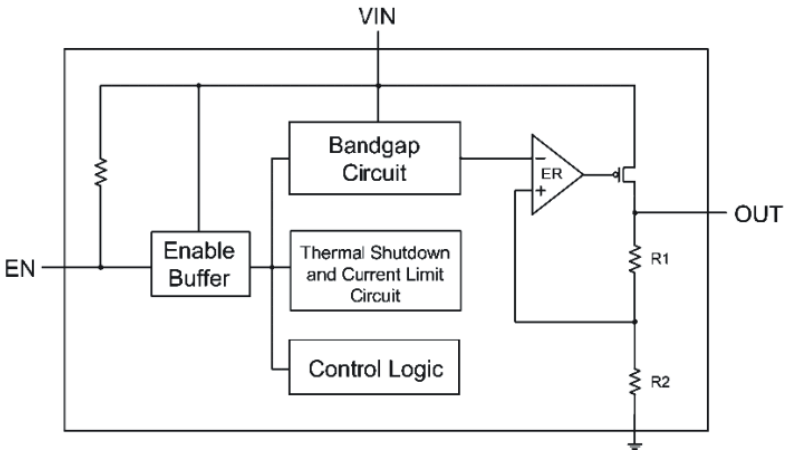


PACKAGE	PIN	SYMBOL	DESCRIPTION
SOT-25	1	VIN	Regulator Input Pin
	2	GND	Ground Pin
	3	EN	Chip Enable Pin
	4	NC	No Connection
	5	VOUT	Regulator Output Pin

Ordering Information

DEVICE	DEVICE CODE
RS7103-XX YY Z	**XX** is nominal output voltage (for example, 15 = 1.5V, 33 = 3.3V, 285 = 2.85V). **YY** is package designator : NE: SOT-25 **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}	10	V
Output Current Limit, $I_{(LIMIT)}$		I_{LIMIT}	500	mA
Junction Temperature		T_J	+155	°C
Thermal Resistance	SOT-25	θ_{JA}	250	°C/W
Power Dissipation	SOT-25	P_D	400	mW
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	-	2.5	-	9.0	V
V_{OUT}	Output Voltage	$V_{IN}=V_{OUT}+1.0V$, I_{OUT}=30mA	-2%	V_{OUT}	+2%	V
I_{MAX}	Output Current (see NOTE 1)	$V_{OUT}+1.0V \leqq V_{IN} \leqq 9.0V$	300	-	-	mA
I_{LIMIT}	Current Limit	-	-	0.5	-	A
I_{SC}	Short Circuit Current	V_{IN}= V_{EN}=5V, V_{OUT}=0V	-	260	300	mA
I_Q	Ground Pin Current	V_{IN}= V_{EN}=5V, No Load	-	40	60	uA
		V_{IN}= V_{EN}=9V, No Load	-	60	100	
I_{SD}	Shutdown Current	$V_{IN}=V_{OUT}+1V$, V_{EN}=0V, No Load	-	0.1	1.0	uA
V_{IH}	EN Pin Input Voltage "H"	(see NOTE 2)	2.0	-	-	V
V_{IL}	EN Pin Input Voltage "L"	(see NOTE 2)	-	-	0.5	V
I_{EN}	EN Pin Leakage Current		-	-	0.1	uA
V_{DROP}	Dropout Voltage	I_{OUT}=300mA	-	400	480	mV
ΔV_{LINE}	Line Regulation	$V_{OUT}+0.5V \leqq V_{IN} \leqq 9.0V$, I_{OUT}=30mA	-	0.2	0.3	%/V
ΔV_{LOAD}	Load Regulation	$V_{IN}=V_{OUT}+1.0V$, $0\mu A \leqq I_{OUT} \leqq 100mA$	-	0.02	0.03	%/mA
e_N	Output Noise	I_{OUT}=100mA , F=1KHz, C_{OUT}=10uF	-	40	-	$uV_{(rms)}$
PSRR	Ripple Rejection	$V_{IN}=V_{OUT}+1V$, I_{OUT}=30mA, F=100Hz, Vripple=$1V_{P-P}$	-	60	-	dB
T_{SD}	Thermal Shutdown Temperature	-	-	160	-	°C
T_{HYS}	Thermal Shutdown Hysteresis	-	-	10	-	°C

NOTES：

1. Measured using a double sided board with 1"x 2" square inches of copper area connected to the GND pins for "heat spreading".
2. EN pin input voltage must be always less than or equal to input voltage.

Detail Description

The RS7103 is a low-dropout linear regulator. The device provides preset 2.5V, 2.85V, and 3.3V output voltages for output current up to 300mA. Other mask options for special output voltages from 1.3V to 5.0V with 100mV increment are also available. As illustrated in function block diagram, it consists of a 1.25V reference, an error amplifier, a P-channel pass transistor, an ON/OFF control logic and an internal feedback voltage divider.

The 1.25V 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 with output current limiter and shutdown logic.

Internal P-channel Pass Transistor

The RS7103 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 conditions when the pass transistor saturates, and use high base-drive currents under large loads. The RS7103 does not suffer from these problems and consumes only 60μA (Typical) of ground pin current 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.

Output Voltage Selection

The RS7103 output voltage is preset at an internally trimmed voltage 2.5V, 2.85V or 3.3V. The output voltage also can be mask-optioned from 1.5V to 5.0V with 100mV increment by special order. The first two digits of part number suffix identify the output voltage (see Ordering Information). For example, the RS7103-33 has a preset 3.3V output voltage.

Current Limit

The RS7103 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 500mA.

Thermal Overload Protection

Thermal overload protection limits total power dissipation in the RS7103. 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 active 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 RS7103 in the event of fault conditions. For continuous operation, the maximum operating junction temperature rating of T_J=+125°C should not be exceeded.

Operating Region and Power Dissipation

Maximum power dissipation of the RS7103 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} x (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 RS7103 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 RS7103 uses a SOT-25 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 180°C/W.

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

$$P_{MAX} = \frac{(T_J - T_A)}{\theta_{JC} + \theta_{CA}} = \frac{(125 - 25)}{250} = 0.40W$$

Thermal characteristics were measured using a double-side board with 1”x 2” square inches of copper area connected to the GND pin for “heat spreading”.

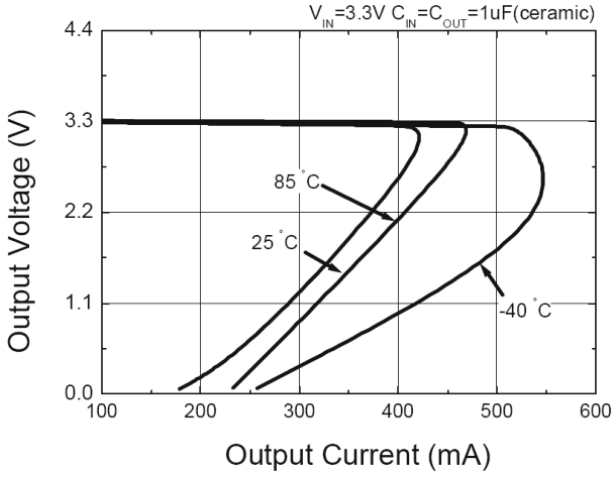
Dropout Voltage

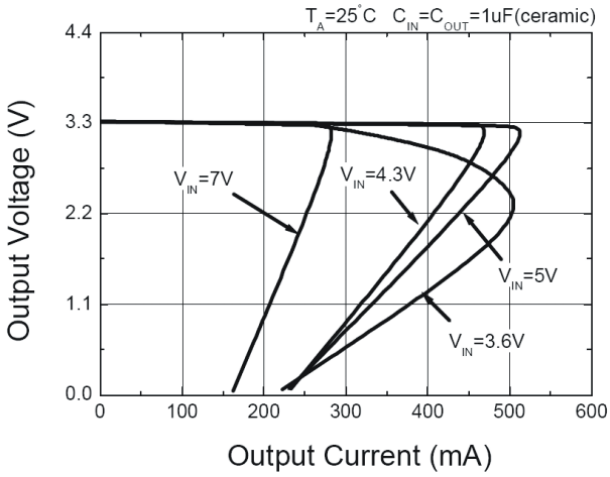
A regulator’s minimum input-output voltage differential, or dropout voltage, determines the lowest usable supply voltage. In battery-powered systems, this will determine the useful end-of-life battery voltage. The RS7103 uses a P-channel MOSFET pass transistor, its dropout voltage is a function of drain-to-source on-resistance ($R_{DS(ON)}$) multiplied by the load current.

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

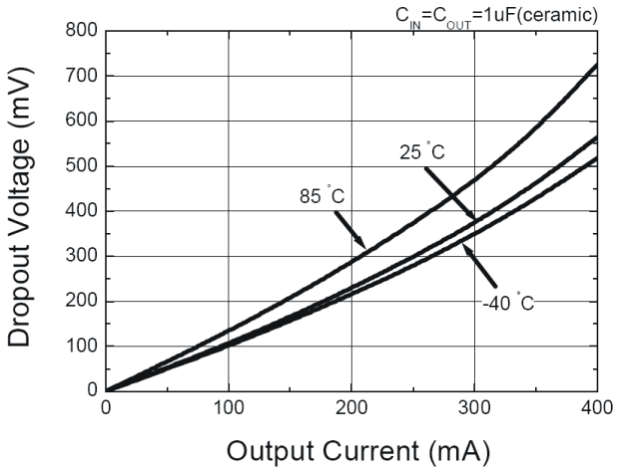
Typical Operating Characteristics

Output Voltage vs. Output Current

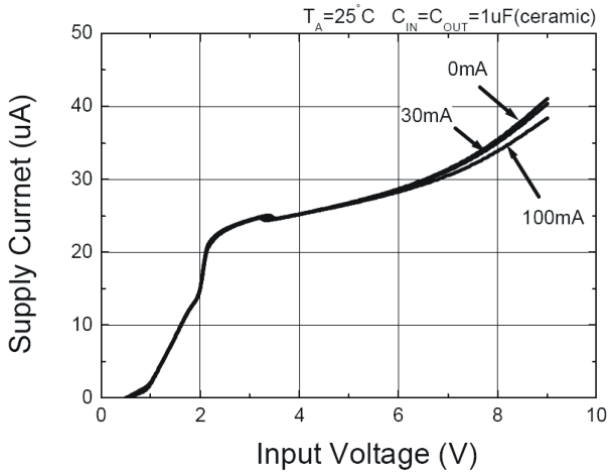




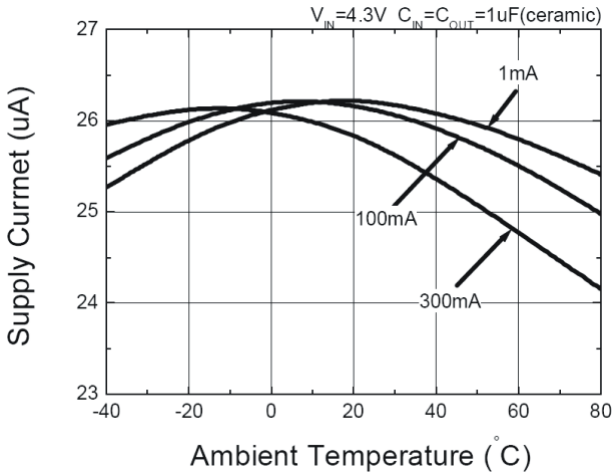
Dropout Voltage vs. Output Current



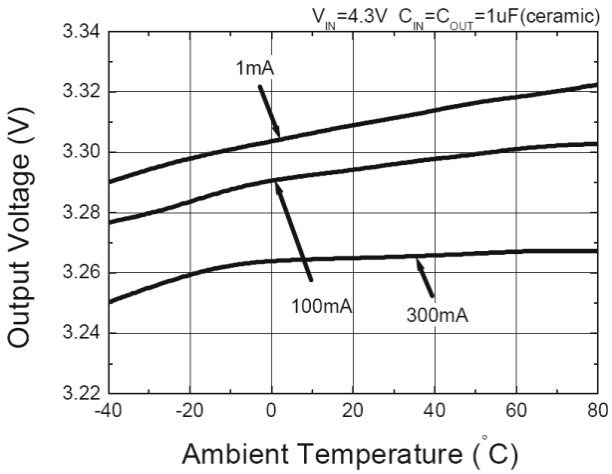
Supply Current vs. Input Voltage



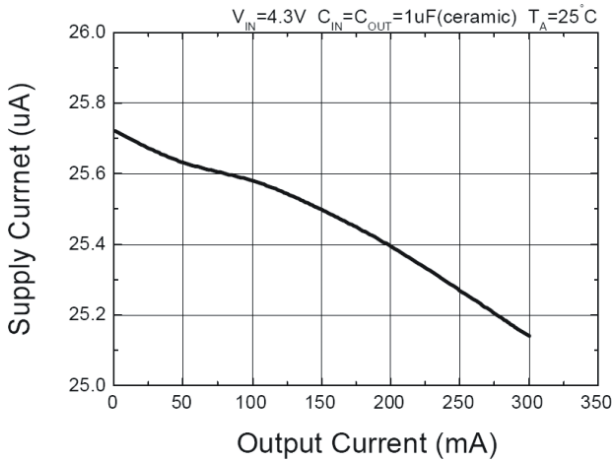
Supply Current vs. Ambient Temperature



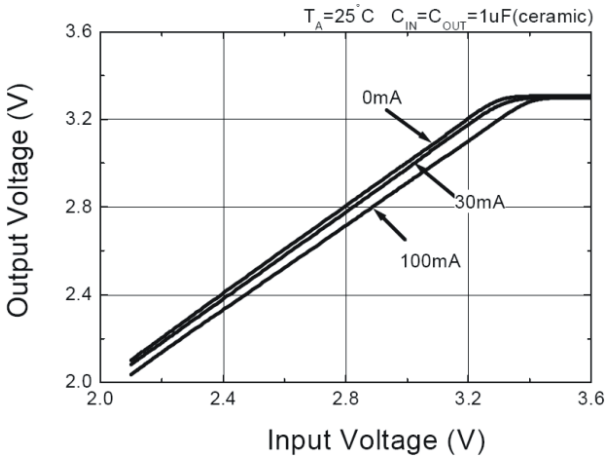
Output Voltage vs. Ambient Temperature



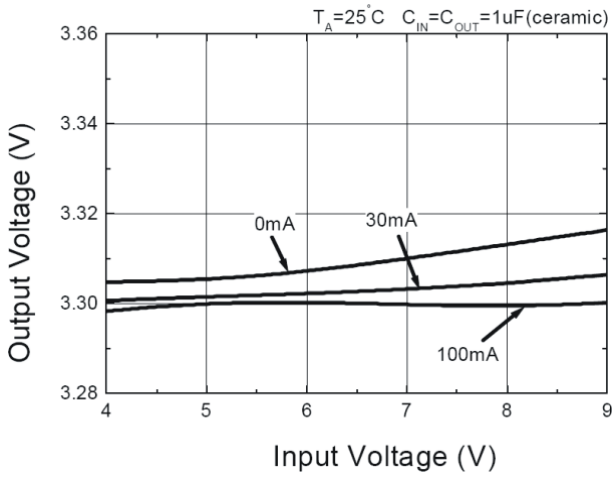
Supply Current vs. Output Current



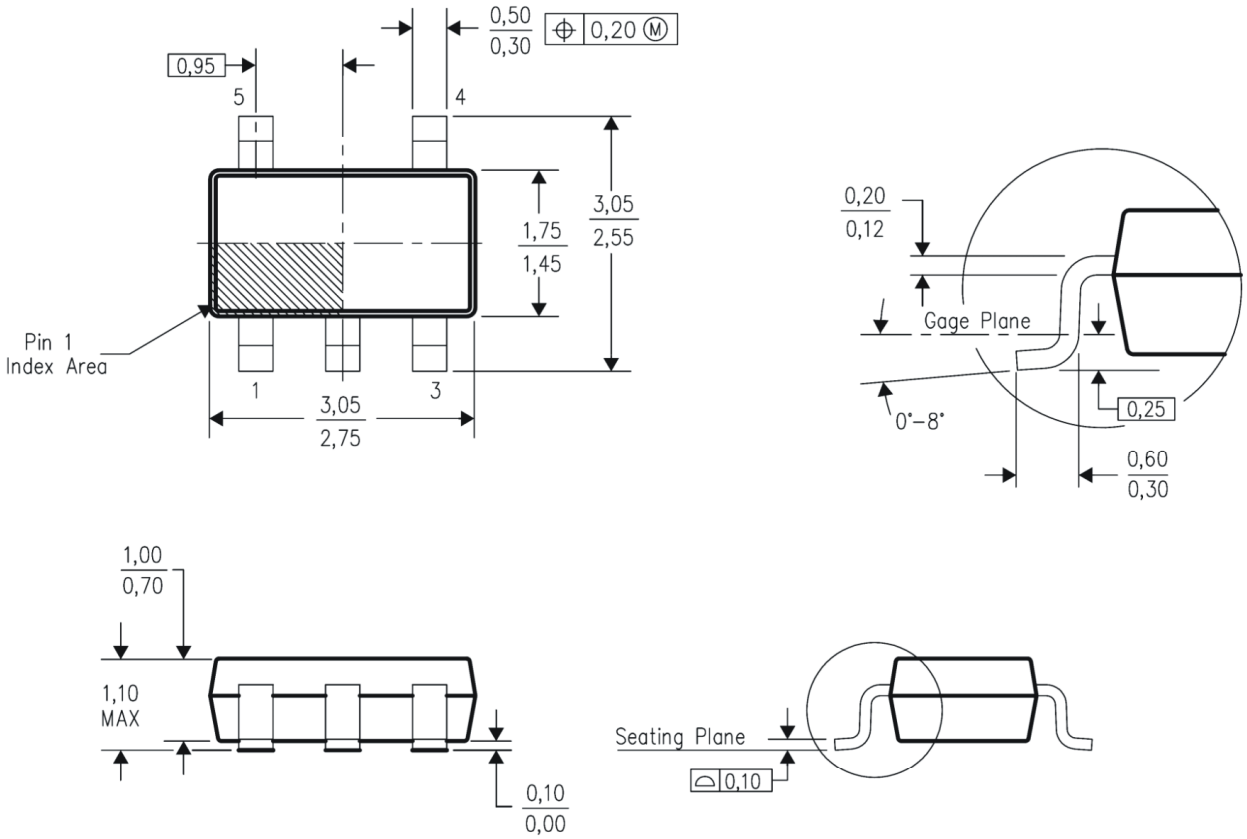
Output Voltage vs. Input Voltage



Output Voltage vs. Input Voltage



SOT-25 Dimension



NOTES:

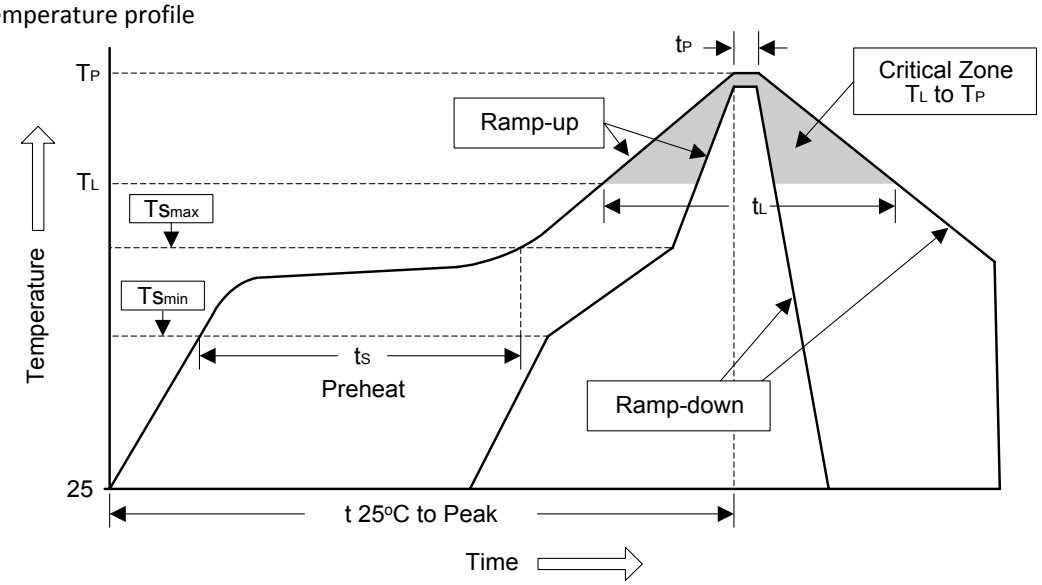
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC MO-193 variation AB (5 pin).

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 (Ts_{min}) - Temperature Max (Ts_{max}) - Time (min to max) (ts)	 100°C 150°C 60~120 sec	 150°C 200°C 60~180 sec
Tsmax to T_L - Ramp-up Rate	 <3°C/sec	 <3°C/sec
Time maintained above: - Temperature (T_L) - Time (t_L)	 183°C 60~150 sec	 217°C 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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