

## RS7215

### 1A Adjustable & Fixed Voltage LDO Linear Regulator with Enable Function & Fast Discharge

#### General Description

The RS7215 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 1.0A output current.

The RS7215 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 1.2V, 1.5V, 2.85V, 3.0V and 3.6V are available by special order only. The output voltage range of the adjustable type is from 1.175V to 5V.

The RS7215 (ADJ type) consists of a 1.175V bandgap reference, an error amplifier, and a P-channel pass transistor. Other features include short-circuit protection and thermal shutdown protection.

The RS7215 (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 RS7215 series devices are available in SOT-223-5, TO-252-5 packages.

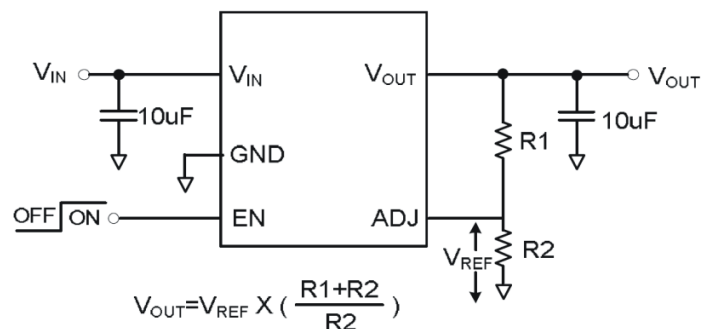
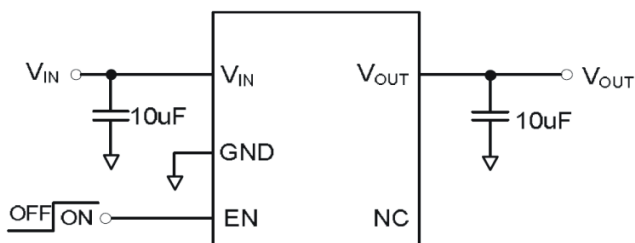
#### Features

- ⊙ Operating Voltage Range : +2.4V to +7.0V
- ⊙ Output Voltages : +1.0V to +5.0V (0.1V Step) (Fixed), +1.175V to +5.0V (ADJ Type)
- ⊙ Dropout Voltage : 700mV@1000mA (Fixed)
- ⊙ Fast Response in Power-on (Fixed Voltage Only)
- ⊙ Low Current Consumption : 60µA (Typ.)
- ⊙ Low ESR Capacitor Compatible
- ⊙ High Ripple Rejection : 55dB (Typ.)
- ⊙ Short Circuit Protection : 600mA (Typ.)
- ⊙ Thermal Overload Shutdown Protection
- ⊙ SOT-223-5, TO-252-5 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

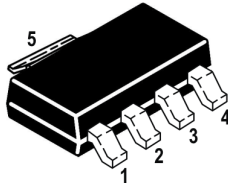


This integrated circuit can be damaged by ESD. Orister Corporation recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

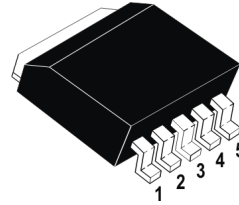
ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

## Pin Assignments

SOT-223-5



TO-252-5



PACKAGE	PIN	SYMBOL	DESCRIPTION
SOT-223-5	1	VIN	Regulator Input Pin
	2	VOUT	Regulator Output Pin
	3	NC/ADJ	No Connect for Fixed Voltage or ADJ Terminal Pin for Adjustable.
	4	EN	Enable Pin
	5	GND	Ground Pin

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TO-252-5	1	VIN	Regulator Input Pin
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	5	EN	Enable Pin

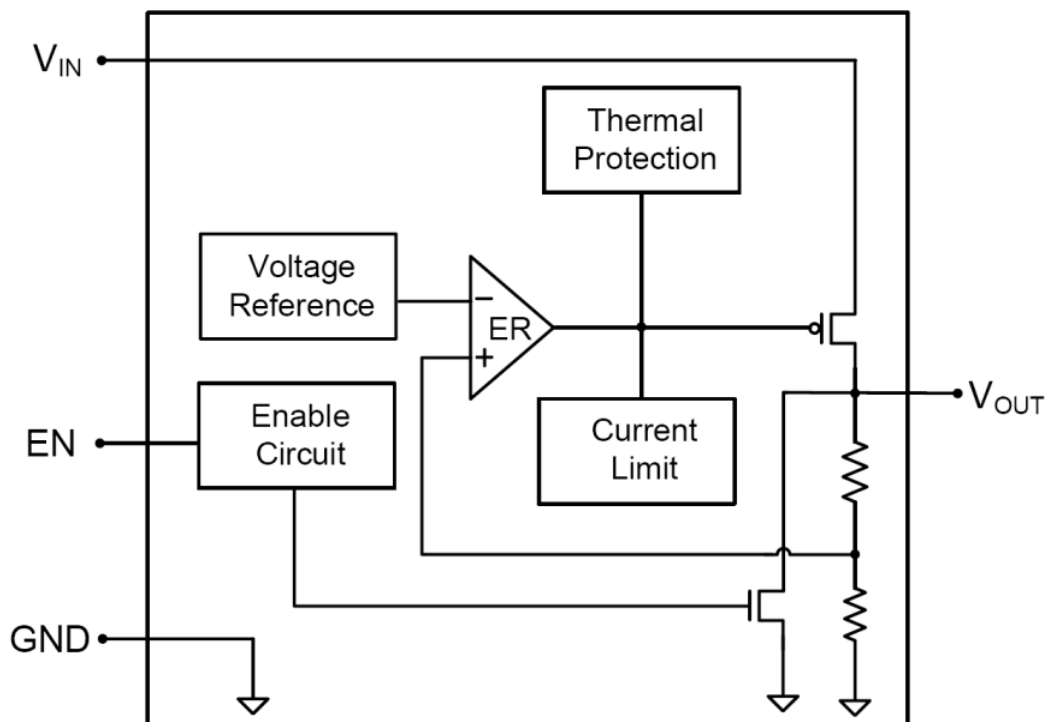
## Ordering Information

DEVICE	DEVICE CODE
RS7215-XX EEE YY Z	<p><b>XX</b> is nominal output voltage (for example, AD=ADJ, 18 = 1.8V, 33 = 3.3V, 285 = 2.85V).  <b>EEE</b> is CE Input Logic &amp; Discharge Function Selection : (see CE &amp; Discharge Function Selection Table)  <b>YY</b> is package designator :                      SK : SOT-223-5                      EJ : TO-252-5  <b>Z</b> is Lead Free designator :                      P: Commercial Standard, Lead (Pb) Free and Phosphorous (P) Free Package                      G: Green (Halogen Free with Commercial Standard)</p>

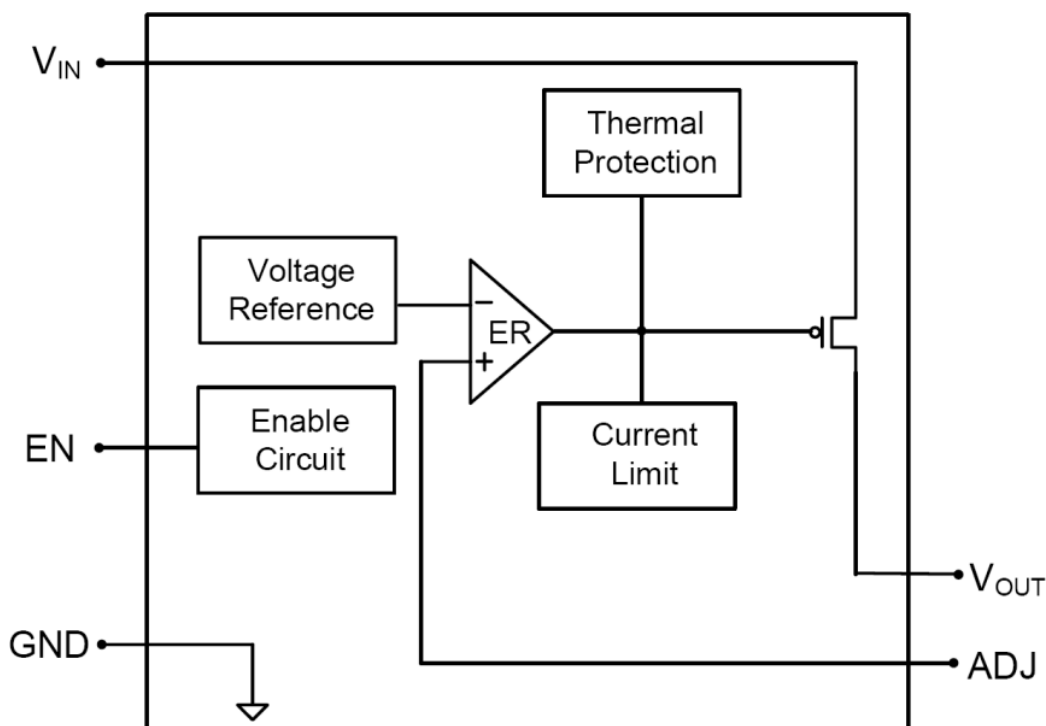
## CE & Discharge Function Selection Table

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



Fixed Voltage Type



Adjustable Voltage Type

## Absolute Maximum Ratings

Parameter	Symbol	Ratings	Units
Input Voltage $V_{IN}$ to GND	$V_{IN}$	9.0	V
Output Current Limit, $I_{LIMIT}$	$I_{LIMIT}$	1.3	A
Junction Temperature	$T_J$	+155	°C
Thermal Resistance	$\theta_{JA}$	SOT-223-5	155
		TO-252-5	90
Power Dissipation	$P_D$	SOT-223-5	900
		TO-252-5	1200
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%	$V_{OUT}$	+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)	$V_{OUT}+1.0\text{V} \leq V_{IN} \leq 7.0\text{V}$ , $V_{OUT} \geq 2.4\text{V}$	1000	-	-	mA	
$V_{REF}$	ADJ Pin Reference Voltage	For Adjustable Voltage Type	-	1.17 5	-	V	
$V_{DROP}$	Dropout Voltage (Fixed Type)	$I_{OUT}=500\text{mA}$ , $V_{OUT}>3.0\text{V}$	-	300	-	mV	
		$I_{OUT}=1000\text{mA}$ , $V_{OUT}>3.0\text{V}$	-	700	-		
	Dropout Voltage (ADJ Type)	$I_{OUT}=1000\text{mA}$ , $V_{OUT}>3.0\text{V}$	-	-	1100		
$\Delta V_{LINE}$	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	
		$V_{OUT}+1.2\text{V} \leq V_{IN} \leq 7\text{V}$ , $I_{OUT}=1\text{mA}$ , $V_{IN} \geq 2.8\text{V}$	-	-	0.2		
$\Delta V_{LOAD}$	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 $1.0\text{A}$ , $V_{IN}=V_{OUT}+1.0\text{V}$	-	60	90	uA	
$I_{SD}$	Shutdown Current	$V_{IN}=V_{OUT}+1\text{V}$ , $EN=0\text{V}$ , No Load	-	0.7	1.05	uA	
$I_{ADJ}$	ADJ Pin Current	$I_{LOAD}=0\text{mA}$ to $1000\text{mA}$ , $V_{IN}=V_{OUT}+1.0\text{V}$	-	0.1	0.15	uA	
$I_{SC}$	Short Circuit Current	-	-	600	-	mA	
PSRR	Ripple Rejection	$I_{OUT}=30\text{mA}$ , $F=1\text{KHz}$ , $C_{OUT}=10\text{uF}$	-	55	-	dB	
$e_N$	Output Noise	$I_{OUT}=100\text{mA}$ , $F=1\text{KHz}$ , $C_{OUT}=10\text{uF}$	-	40	-	$\text{uV}_{(rms)}$	
$V_{IH}$	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	$\Omega$	
$T_{DIS}$	Discharge Time	$V_{OUT}=3.3\text{V}$ to $0\text{V}$ , $C_{OUT}=1\text{uF}$ , For Fixed Voltage Type	-	70	100	us	
$T_{SD}$	Thermal Shutdown Temperature	-	-	150	-	°C	
$T_{HYS}$	Thermal Shutdown Hysteresis	-	-	20	-	°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 RS7215 is a low-dropout linear regulator. The device provides preset 1.8V, 2.5V and 3.3V output voltages for output current up to 1.0A. Adjustable output voltage and other mask options for special output voltages are also available. As illustrated in function block diagram, it consists of a 1.175V 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 fixed voltage types 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<sub>OUT</sub> pin. Additional blocks include an output current limiter, thermal sensor, and shutdown logic.

### Internal P-channel Pass Transistor

The RS7215 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 RS7215 does not suffer from these problems and consumes only 60µA (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<sub>IN</sub> and V<sub>OUT</sub> is switched off, allowing current consumption to be drastically reduced. The V<sub>OUT</sub> pin enters the GND level through the internal discharge path between V<sub>OUT</sub> and GND pins.

### Fast Discharge Function

The RS7215 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 RS7215, 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 RS7215-33 has a preset 3.3V output voltage.

For adjustable voltage type of RS7215, the output voltage is set by comparing the feedback voltage at adjust terminal to the internal bandgap reference voltage. The reference voltage V<sub>REF</sub> is 1.175V. The output voltage is given by the equation:

$$V_{OUT} = V_{REF} \times \left( 1 + \frac{R1}{R2} \right)$$

### Current Limit

The RS7215 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 1.3A.

### Thermal Overload Protection

Thermal overload protection limits total power dissipation in the RS7215. When the junction temperature exceeds T<sub>J</sub>=+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 RS7215 in the event of fault conditions. For continuous operation, the absolute maximum operating junction temperature rating of T<sub>J</sub>=+125°C should not be exceeded.

## Operating Region and Power Dissipation

Maximum power dissipation of the RS7215 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:

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

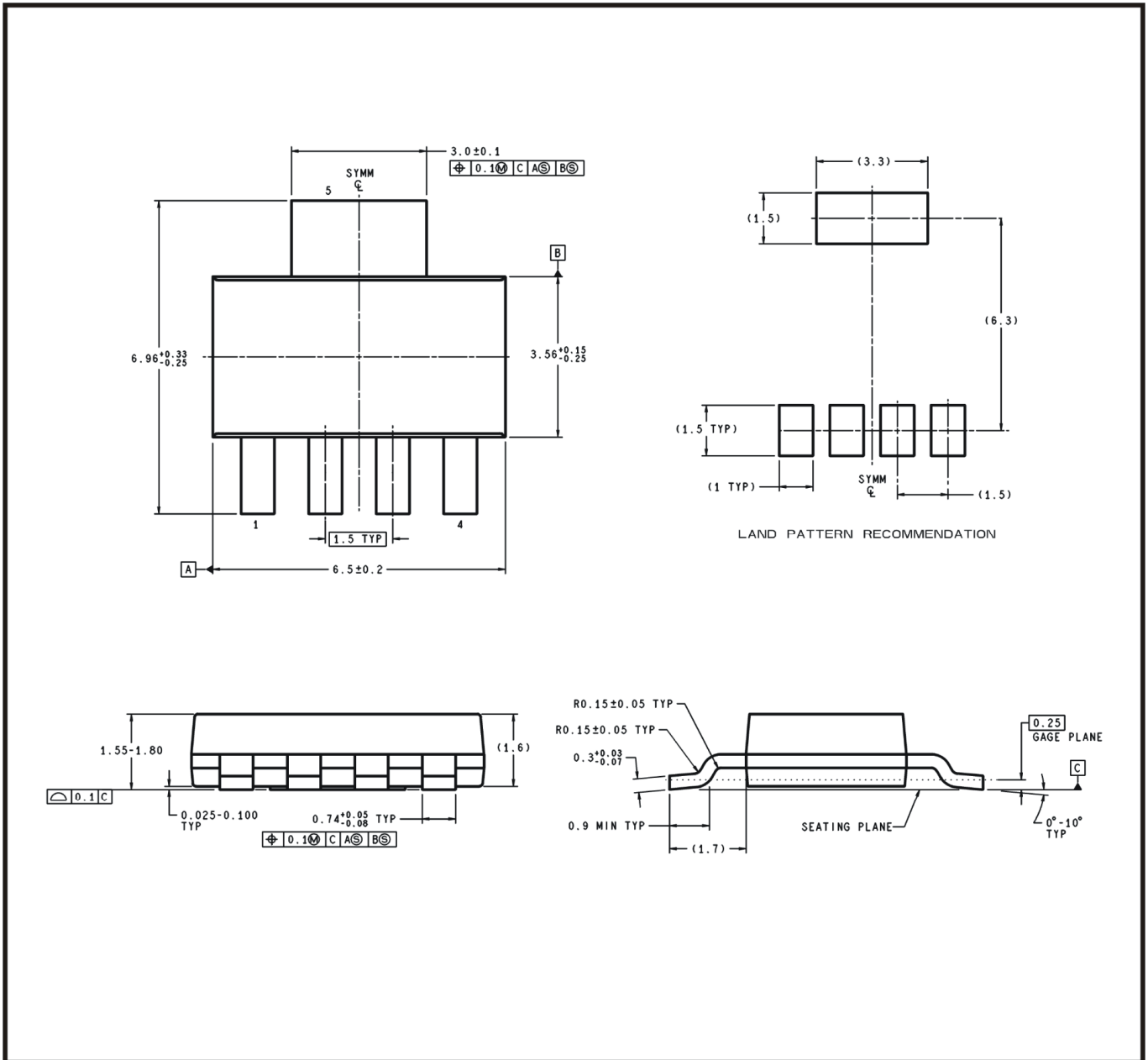
Where  $(T_J - T_A)$  is the temperature difference between the RS7215 die junction and the surrounding air,  $\theta_{JC}$  is the thermal resistance of the package chosen, and  $\theta_{CA}$  is the thermal resistance through the printed circuit board, copper traces and other materials to the surrounding 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 RS7215 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.

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

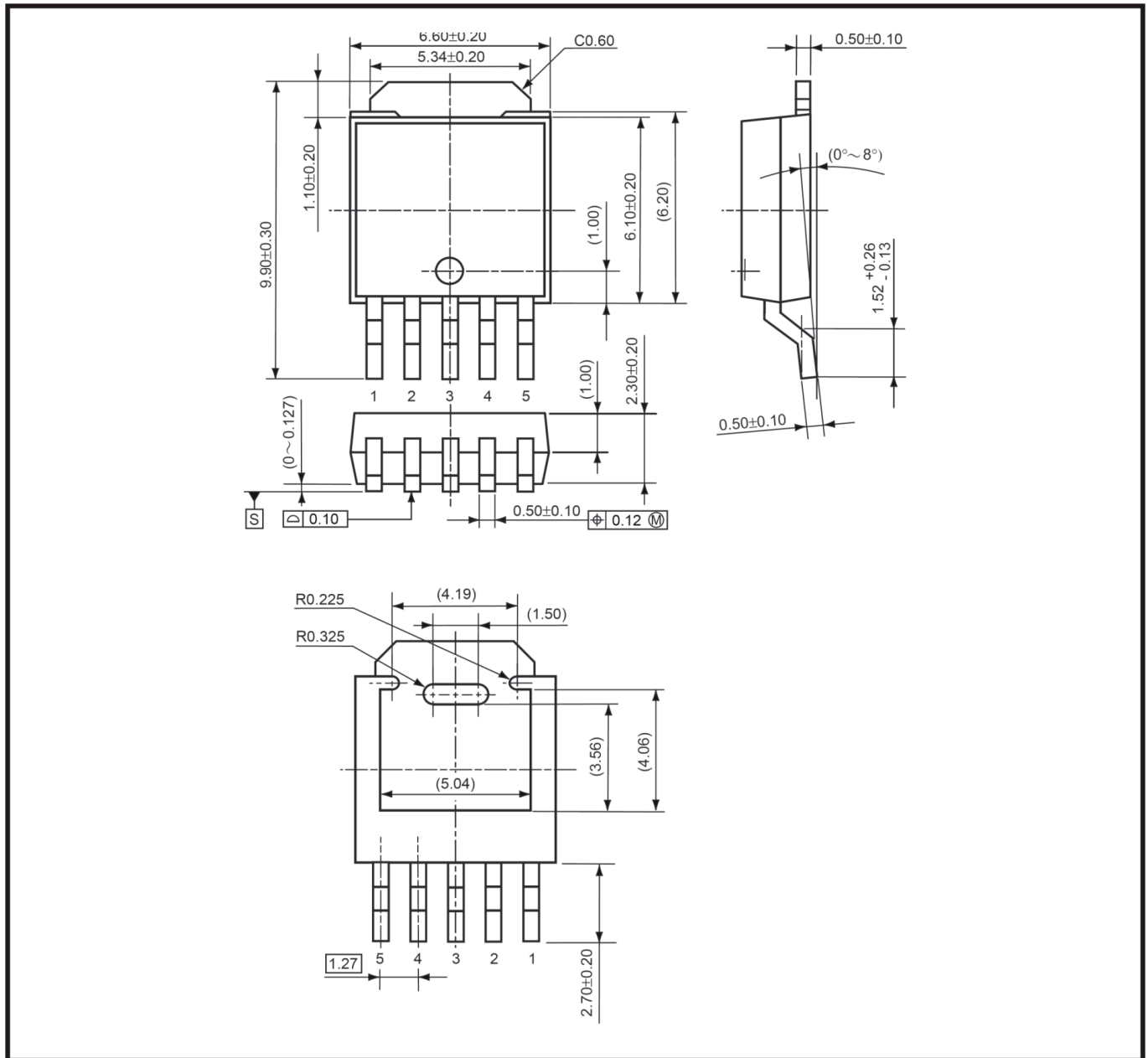
## SOT-223-5 Dimension



### 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.

## TO-252-5 Dimension



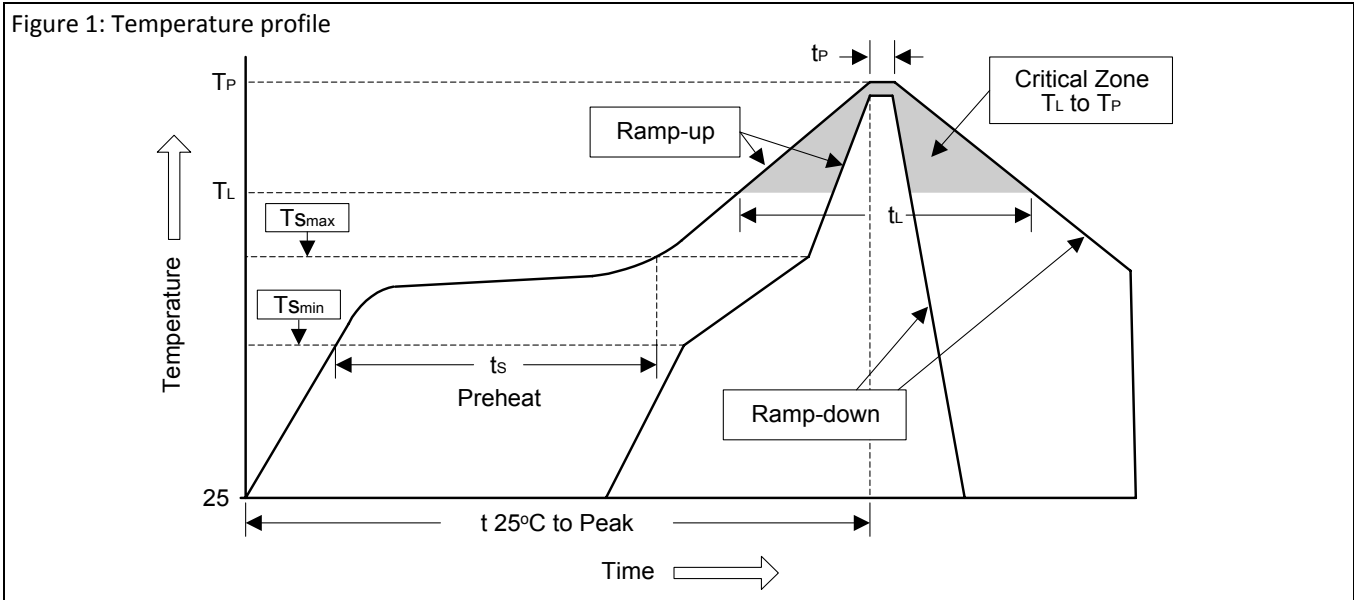
**NOTES:**

- 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.



## Soldering Methods for Orister's Products

1. Storage environment: Temperature=10°C~35°C Humidity=65%±15%
2. Reflow soldering of surface-mount devices



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

## ***Important Notice:***

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