

RS7202

250mA Low Quiescent Linear Regulator with Enable

General Description

The RS7202 series is a positive voltage regulator with high accuracy output voltage and ultra-low quiescent current which is typically 2.0µA. The device is ideal for handheld communication equipments and battery powered applications which require low quiescent current.

The RS7202 consists of a bandgap reference voltage source, an error amplifier, a P-channel pass transistor, a resistor-divider for setting output voltage, a current limiter, and temperature limit protection circuit. The high-accuracy output voltage is preset at an internally trimmed voltage 1.8V, 2.5V or 3.3V. Other output voltages can be mask- optioned from 1.2V to 5.0V with 100mV increment except the RS7202-13 which has 1.3V output voltage and RS7202-185 which has 1.85V output voltage.

The RS7202 has been designed to be used with low cost ceramic capacitors and requires a minimum output capacitor of 1.0µF. The device is available in SOT-25 package.

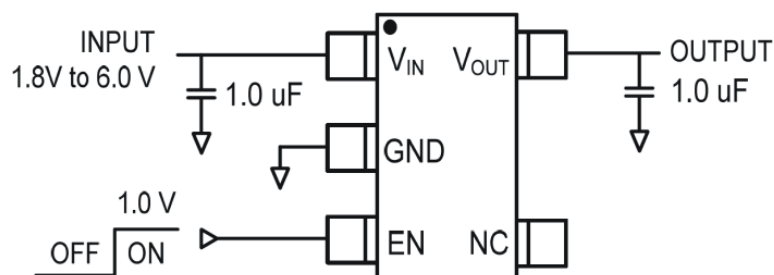
Features

- 2.0µA Quiescent Current (Typ.)
- Operating Voltages Range : +1.8V to +6V
- Output Voltages Range : +1.2V to +5.0V with 100mV Increment
- Maximum Output Current : 250mA
- Low Dropout: 150mV@100mA ($V_{OUT} \geq 2.0V$)
- High Accuracy of Output Voltage :
 - ±2.0% : $V_{OUT} \geq 2.5 V$
 - ±50mV : $V_{OUT} \leq 2.5 V$
- High Ripple Rejection : 60dB
- Output Current Limit Protection (350mA)
- Short Circuit Protection (200mA)
- Thermal Overload Shutdown Protection
- Low ESR Capacitor Compatible
- SOT-25 Package
- RoHS Compliant and 100% Lead (Pb)-Free and 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



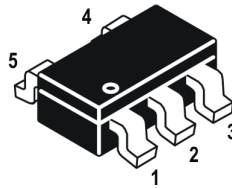


This integrated circuit can be damaged by ESD. Orister Corporation recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

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



PACKAGE	PIN CODE (NE)	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

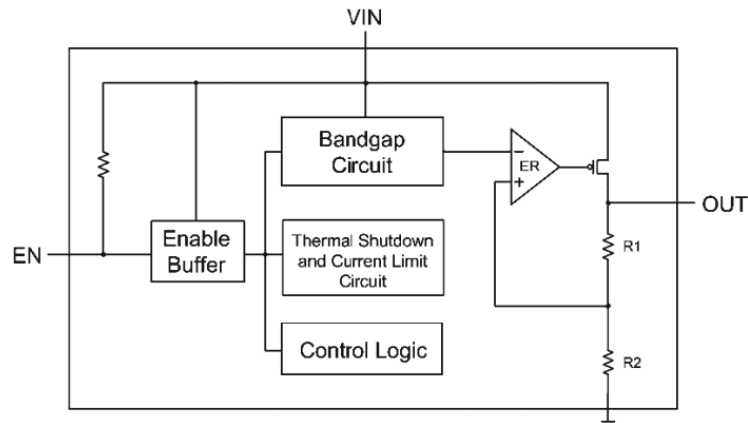
Ordering Information

DEVICE	DEVICE CODE
RS7202-XX EE YY Z	<p>XX is nominal output voltage (for example, 12 = 1.2V, 20 = 2.0V, 33= 3.3V, 285 = 2.85V). EE is EN Input Logic, Internal Pull-Up / Down Resistor : (see EN Functions Table) YY is package & Pin Assignments 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)</p>

EN Functions Table

EE Code	EN	Operational State
GR	H	ON
	L	OFF
GP	H	OFF
	L	ON

Block Diagram



Absolute Maximum Ratings

Parameter	Symbol	Ratings	Units
Input Voltage V_{IN} to GND	V_{IN}	7.0	V
EN to GND Voltage	-	7.0	V
EN to Input Voltage	-	0.3	V
Output Current Limit, I_{LIMIT}	I_{LIMIT}	350	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 ($T_A=25^\circ\text{C}$, unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage	-	1.8	-	6.0	V
V_{OUT}	Output Voltage	$V_{IN}=V_{OUT}+1.0V, V_{OUT} \leq 2.5V$	-0.05	V_{OUT}	+0.05	V
		$V_{IN}=V_{OUT}+1.0V, V_{OUT} \geq 2.5V$	-2%		+2%	
I_{MAX}	Output Current	-	250	-	-	mA
I_{LIMIT}	Current Limit	-	-	0.5	-	A
I_{SC}	Short Circuit Current	$V_{OUT}=0V, V_{IN} > V_{OUT}+0.48V$	-	200	300	mA
I_Q	Quiescent Current	$I_{LOAD}=0mA, V_{IN}=V_{OUT}+1.0V$	-	2.0	4.5	uA
V_{DROP}	Dropout Voltage	$V_{OUT} \geq 2.5V, I_{OUT}=100mA$	-	150	200	mV
ΔV_{LINE}	Line Regulation	$V_{OUT}+1.0V \leq V_{IN} \leq 6V, I_{LOAD}=1mA$	-	0.1	0.2	%/V
ΔV_{LOAD}	Load Regulation	$I_{OUT}=1mA$ to 100mA	-	0.01	0.02	%/mA
V_{IH}	EN Pin Input Voltage “H”	(see note 2)	1.0	-	-	V
V_{IL}	EN Pin Input Voltage “L”	(see note 2)	-	-	0.3	V
I_{EN}	EN Pin Leakage Current	-	-	0.05	0.1	uA
e_N	Output Noise	$F=10KHz, C_{OUT}=1\mu F$	-	150	-	$\mu V_{(rms)}$
PSRR	Ripple Rejection	$F=100Hz, C_{OUT}=1\mu F$	-	60	-	dB
T_C	Output Voltage Temperature Coefficient	$I_{OUT}=1mA, -40^\circ\text{C} \leq T_A \leq 80^\circ\text{C}$	-	100	-	ppm/°C
T_{HYS}	Thermal Shutdown Hysteresis	-	-	10	-	°C

Detail Description

The RS7202 is a low quiescent current LDO linear regulator. The device provides preset 1.8V, 2.5V and 3.3V output voltages for output current up to 350mA. Other mask options for special output voltages from 1.5V to 5.0V with 100mV increment are also available. As illustrated in function block diagram, it consists of a 1.23V voltage, error amplifier, a P-channel pass transistor, an ON/OFF control logic, and an internal feedback voltage divider.

The 1.23V 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 RS7202 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 RS7202 does not suffer from these problems and consumes only 2.0 μ A (Typical) of current consumption under light loads.

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 due to the several M Ω resistance of the feedback voltage divider between V_{OUT} and GND pins.

Output Voltage Selection

The RS7202 output voltage is preset at an internally trimmed voltage 1.8V, 2.5V or 3.3V. The output voltage also can be mask-optional from 1.2V to 5.0V with 100mV increment by special order (but only 1.28V in stead of 1.3V). The first two digits of part number suffix identify the output voltage (see **Ordering Information**). For example, RS7202-33 has a preset 3.3V output voltage.

Current Limit

The RS7202 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 350mA.

Thermal Overload Protection

Thermal overload protection limits total power dissipation in the RS7202. When the junction temperature exceeds $T_J=+155^\circ\text{C}$, 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 10°C , resulting in a pulsed output during continuous thermal overload conditions.

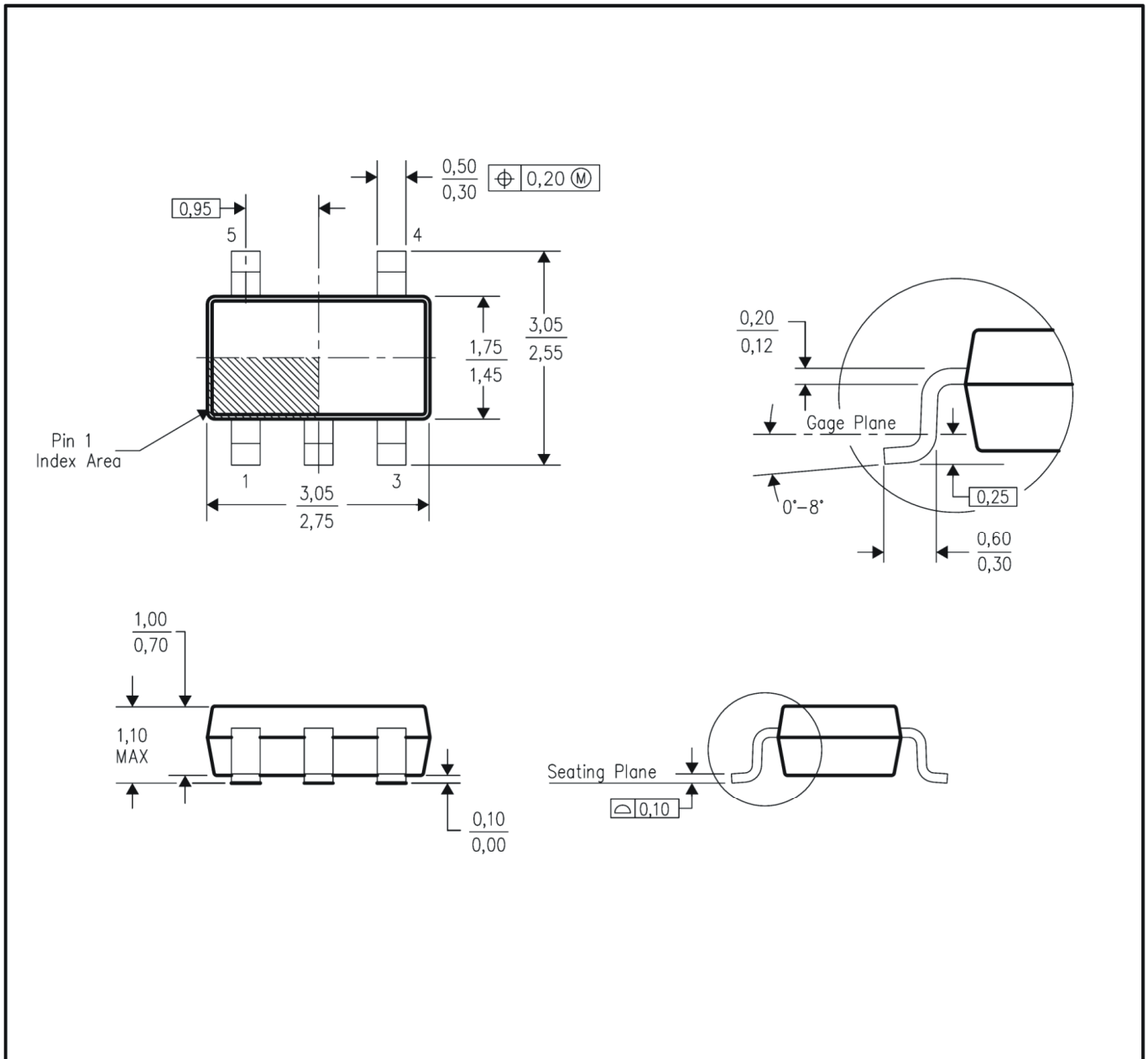
Thermal overload protection is designed to protect the RS7202 in the event of fault conditions. For continuous operation, the maximum operating junction temperature rating of $T_J=+125^\circ\text{C}$ should not be exceeded.

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 RS7202 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.

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

SOT-25 Dimension



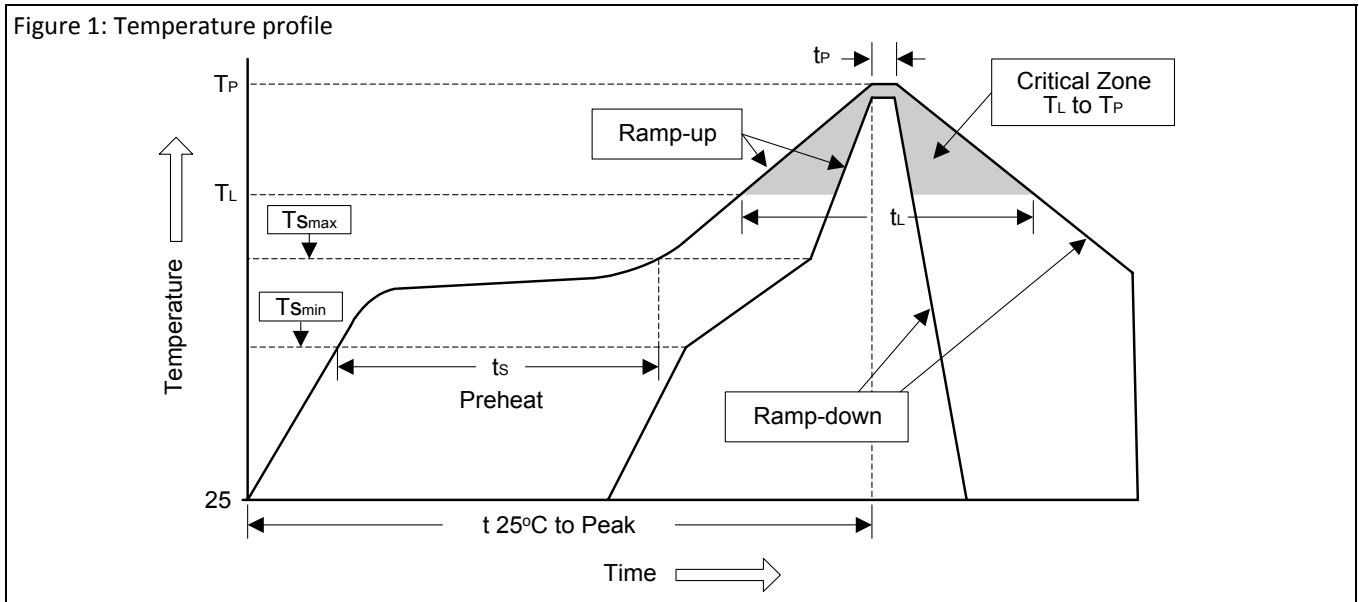
NOTES:

- 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).

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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