

RS6501

150KHz, 40V, 2A PWM Buck DC/DC Converter

General Description

The RS6501 is Monolithic IC that design for a step-down DC/DC Converter, and own the ability of driving a 2A load without additional transistor component.

The output version included 3.3V, 5V, 12V and an adjustable type. It operates at a switching frequency of 150KHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. Other features include a guaranteed $\pm 4\%$ tolerance on output voltage under specified input voltage and output load conditions, and $\pm 15\%$ on the oscillator frequency. Regarding protected function, thermal shutdown is to prevent over temperature operating from damage, and current limit is against over current operating of the output switch.

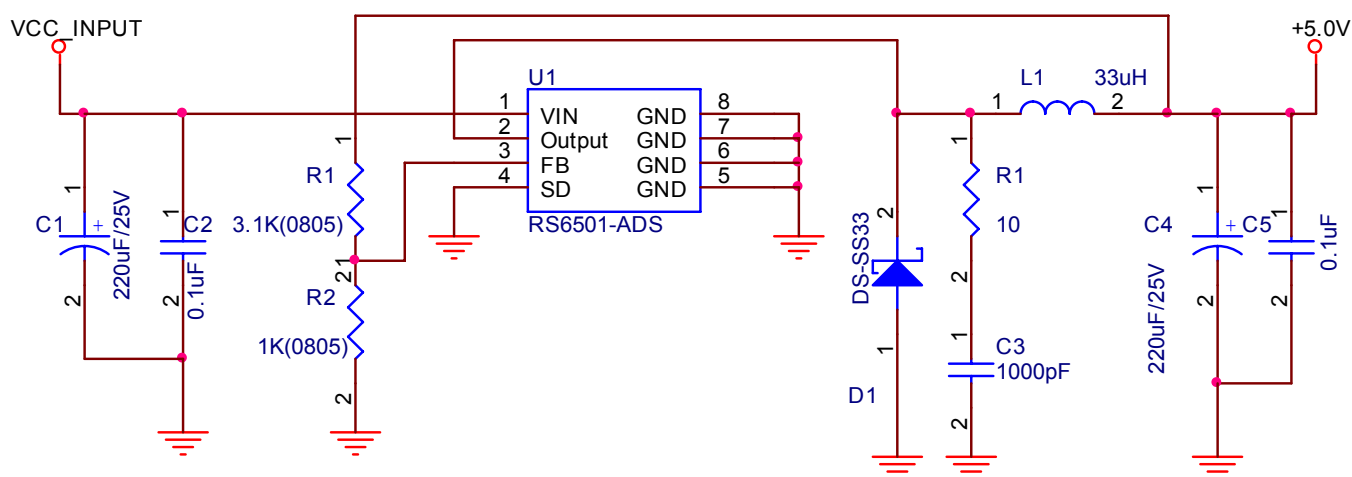
Features

- 3.3V, 5V, 12V and adjustable
- Adjustable version output voltage range: 1.23-37V
- $\pm 4\%$ max over line and load conditions
- 150KHz $\pm 15\%$ fixed switching frequency
- TTL shutdown capability
- Operating voltage can be up to 40V
- Output load current: 2A
- SOP-8 package
- Low power standby mode
- Thermal-shunt down and current-limit protection
- Built-in switching a transistor on chip, requires only 4 external components

Applications

- Simple High-efficiency step-down regulator
- Positive to negative converter
- On-card switching regulators

Application Circuits



Adjustable Output Voltage Version

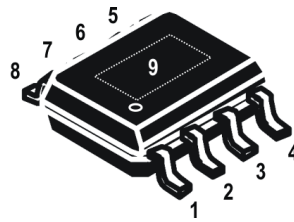


This integrated circuit can be damaged by ESD. Orister Corporation recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

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

SOP-8(EP)

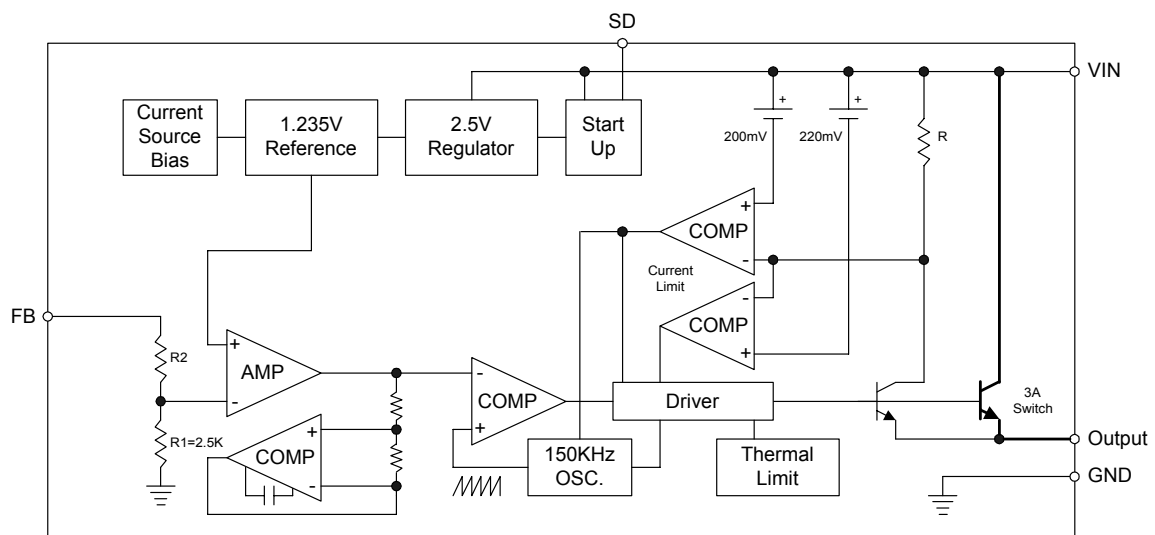


PACKAGE	PIN	SYMBOL	DESCRIPTION
SOP-8(EP)	1	VIN	Regulator Input Pin
	2	VOUT	Regulator Output Pin
	3	FB	Output Voltage Feed Back Control Pin
	4	SD	ON/OFF Shutdown Pin
	5, 6, 7, 8, 9	GND	Ground Pin

Ordering Information

DEVICE	DEVICE CODE
RS6501-XX YY Z	XX is nominal output voltage (for example, AD=ADJ, 33 = 3.3V, 50 = 5.0V, 12 = 12V). Y is package designator : SE : SOP-8(EP) 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 ^(Note1)

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	40	V
On/Off Pin Input Voltage	V_{SD}	-0.3~+25	V
Feedback Pin Voltage	V_{FB}	-0.3~+25	V
Output Voltage to Ground	V_{OUT}	-1	V
Power Dissipation	P_D	Internally Limited	W
Operating Temperature	T_{opr}	0~+70	°C
Storage Temperature	T_{stg}	-65~+150	°C
Operating Junction Temperature Range	T_J	-40~+125	°C
Operating Voltage	V_{OP}	+4.5~+40	V

Electrical Characteristics (Continued)

Specifications with boldface type apply over for full operating temperature range, the other type are for $T_J=25^{\circ}\text{C}$ ^(Note 2)

Part No.	Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
RS6501-3.3V	Output Voltage	V_{OUT}	$5V \leq V_{IN} \leq 40V, 0.2A \leq I_{LOAD} \leq 2A$	3.135	3.3	3.465	V
	Efficiency	η	$V_{IN}=12V, I_{LOAD}=2A$	-	72	-	%
RS6501-5.0V	Output Voltage	V_{OUT}	$7V \leq V_{IN} \leq 40V, 0.2A \leq I_{LOAD} \leq 2A$	4.750	5.0	5.250	V
	Efficiency	η	$V_{IN}=12V, I_{LOAD}=2A$	-	79	-	%
RS6501-12V	Output Voltage	V_{OUT}	$15V \leq V_{IN} \leq 40V, 0.2A \leq I_{LOAD} \leq 2A$	11.40	12.0	12.60	V
	Efficiency	η	$V_{IN}=25V, I_{LOAD}=2A$	-	90	-	%
RS6501-ADJ	Reference Voltage	V_{FB}	$4.5V \leq V_{IN} \leq 40V, 0.2A \leq I_{LOAD} \leq 2A$ V_{OUT} programmed for 3V	1.193	1.230	1.280	V
	Efficiency	η	$V_{IN}=12V, I_{LOAD}=2A$	-	72	-	%

All Output Voltage Versions Electrical Characteristics

Specifications with **boldface type** apply over for full operating temperature range, the other type are for $T_J=25^{\circ}\text{C}$

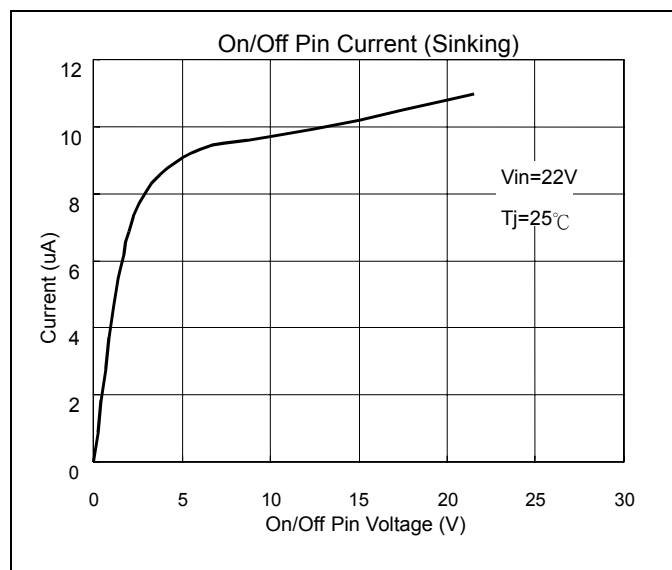
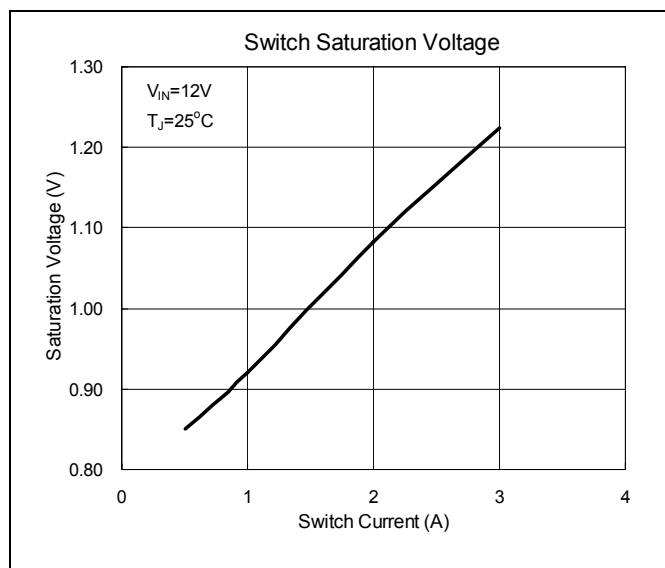
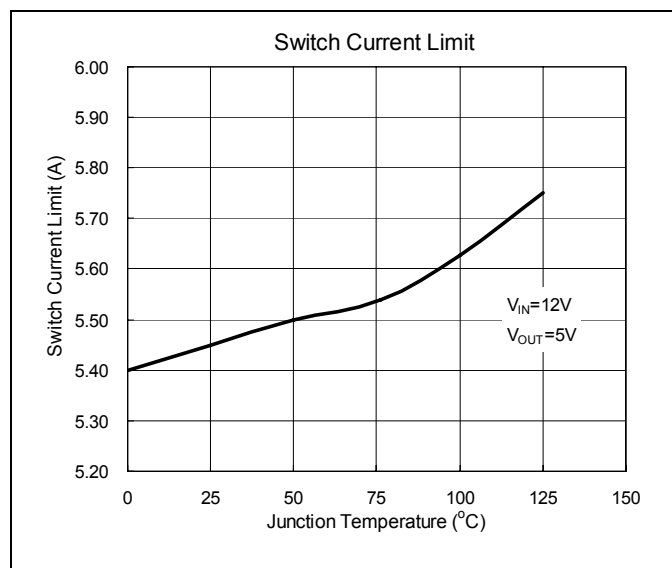
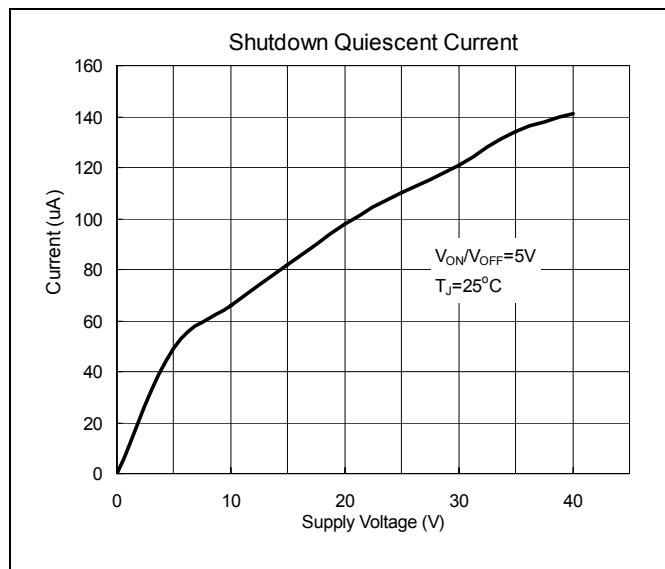
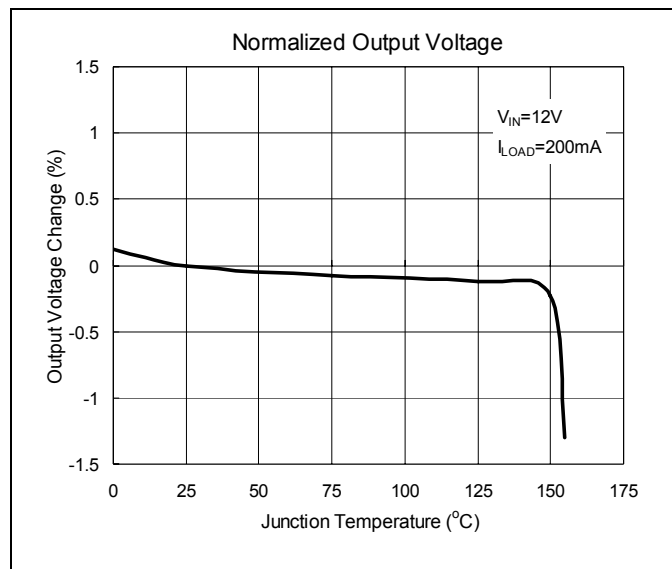
(Unless otherwise specified, $V_{IN}=12V$ for the 3.3V, 5V, and adjustable version and $V_{IN}=24V$ for the 12V version, $I_{LOAD}=500\text{mA}$)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Device Parameters						
Feedback Bias Current	I_b	Adjustable Version Only, $V_{FB}=1.3V$	-	40	50 100	nA
Oscillator Frequency	f_o	(Note 5)	127 110	150	173 173	KHz
Saturation Voltage	V_{SAT}	$I_{OUT}=2A$ (Note 6,7)	-	1.16	1.4 1.5	V
Max. Duty Cycle (ON) Min. Duty Cycle (OFF)	DC	(Note 7) (Note 8)	-	100 0	-	%
Current Limit	I_{CL}	Peak Current (Note 6,7)	-	3.6	-	A
Output Leakage Current	I_L	Output=0V (Note 6,8)	-	-	50	uA
Quiescent Current	I_Q	(Note 8)	-	5	30	mA
Standby Quiescent Current	I_{STBY}	ON/OFF pin=5V (Note 9)	-	85	200 300	uA
Thermal Resistance	θ_{JC}	SOP-8 Junction to Case	-	15	-	°C/W
	θ_{JA} (Note 10)	SOP-8 Junction to ambient	-	70	-	°C/W
ON/OFF Control						
ON/OFF Pin Logic Input Threshold Voltage	V_{IH}	Low (Regulator ON)	-	1.4	0.6	V
	V_{IL}	High (Regulator OFF)	2.0		-	
ON/OFF Pin Input Current	I_{IH}	$V_{LOGIC}=2.5V$ (Regulator OFF)	-	6	15	uA
	I_{IL}	$V_{LOGIC}=0.5V$ (Regulator ON)	-	0.02	5	

NOTE:

1. Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics.
2. External components such as the catch diode, inductor, input and output capacitors, and voltage programming resistors can affect switching regulator system performance.
3. Typical numbers are at 25 °C and represent the most likely norm.
4. All limits guaranteed at room temperature (standard type face) and at temperature extremes (bold type face). All room temperature limits are 100% production tested. All limits at temperature extremes are guaranteed via correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).
5. The switching frequency is reduced when the second stage current limit is activated.
6. No diode, inductor or capacitor connected to output pin.
7. Feedback pin removed from output and connected to 0V to force the output transistor switch ON.
8. Feedback pin removed from output and connected to 12V for the 3.3V, 5V, ADJ. version, and 15V for the 12V version, to force the output transistor switch OFF.
9. $V_{IN}=40V$.
10. Junction to ambient thermal resistance. (With copper area of approximately $3in^2$)

Characteristics Curve



Top View:

- Overall width: $0.1968 (4,98)$ inches, $0.189 (4,80)$ inches.
- Overall height: $0.244 (6,20)$ inches, $0.2284 (5,80)$ inches.
- Pin 1 location: $0.1574 (4,00)$ inches, $0.1497 (3,80)$ inches.
- Pin 5 location: $0.244 (6,20)$ inches, $0.2284 (5,80)$ inches.
- Feature Control Frame for Pin 1: $\oplus 0.010 (0,25) \text{ (M) B (M)}$

Bottom View:

- Overall width: $0.150 (3,81)$ inches, $0.130 (3,30)$ inches.
- Overall height: $0.110 (2,79)$ inches, $0.090 (2,29)$ inches.
- Feature Control Frame for Pin 1: $\oplus 0.010 (0,25) \text{ (M) C A (M) B (S)}$

Side View:

- Base Plane to Seating Plane: $0.050 (1,27)$ inches.
- Seating Plane to Pin 1: $0.018 (0,46)$ inches, $0.016 (0,41)$ inches.
- Pin 1 to Pin 5: $0.0688 (1,75)$ inches, $0.0532 (1,35)$ inches.
- Pin 5 to Pin 1: $0.004 (0,10)$ inches, $0.001 (0,03)$ inches.
- Feature Control Frame for Pin 1: $\oplus 0.010 (0,25) \text{ (M) C A (M) B (S)}$
- Feature Control Frame for Pin 5: $\oplus 0.015 (0,38) \text{ (M) Z X (S)}$

Detail View:

- Detail 1: $0.0196 (0,50)$ inches, $0.0099 (0,25)$ inches, $\times 45^\circ$.
- Detail 2: $0.0098 (0,25)$ inches, $0.0075 (0,20)$ inches.
- Detail 3: $0.050 (1,27)$ inches, $0.016 (0,41)$ inches, $0^\circ - 8^\circ$.

Bottom View Heat Sink:

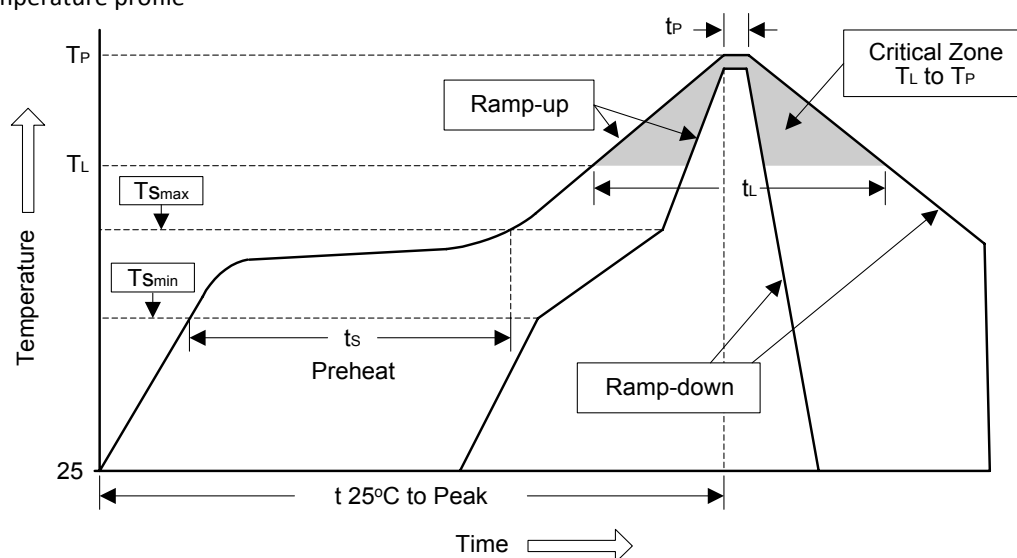
- A. All linear dimensions are in millimeters (inches).
- B. This drawing is subject to change without notice.
- C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0.15) per end.
- D. Body width dimension does not include inter-lead flash or protrusions. Inter-lead flash and protrusions shall not exceed 0.010 (0.25) per side.
- E. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the cross-hatched area.
- F. Lead dimension is the length of terminal for soldering to a substrate.
- G. The lead width, as measured 0.014 (0.36) or greater above the seating plane, shall not exceed a maximum value of 0.024 (0.61).
- H. Lead to lead coplanarity shall be less than 0.004 (0.10) form Seating Plane.
- I. 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 (TL to TP)	<3°C/sec	<3°C/sec
Preheat		
- Temperature Min (Tsmmin)	100°C	150°C
- Temperature Max (Tsmmax)	150°C	200°C
- Time (min to max) (ts)	60~120 sec	60~180 sec
Tsmmax to TL		
- Ramp-up Rate	<3°C/sec	<3°C/sec
Time maintained above:		
- Temperature (TL)	183°C	217°C
- Time (tL)	60~150 sec	60~150 sec
Peak Temperature (TP)	240°C +0/-5°C	260°C +0/-5°C
Time within 5°C of actual Peak Temperature (tp)	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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