3W WLED Step-up DC-DC Converter

General Description

The RP6502 is a high power, high efficiency boost converter for WLED applications. RP6502 can support output current up to 750mA by setting an external resistor. Since RP6502 has high efficiency over a wide range of loading and startup voltage as low as 0.7V, it is suitable for portable devices.

RP6502 also provides Soft Start, Under Voltage Lockout and Over Voltage Protection functions. RP6502 is available in a SOT-23-6 package.

Features

- **Adjustable Output Current: up to 750mA**
- **LX Switch on Resistance: 100mΩ**
- **Low Quiesceng Current: 1mA**
- **Internal Soft Start**
- **Low Startup Voltage: 0.7V (Typ.)**
- **Over Voltage Protection**
- **SOT-23-6 Package**

Ordering Information

RP6502□□

- Package Type
  E: SOT-23-6
- Operating Temperature Range
  G : Green (Halogen Free with Commercial Standard)

Note :

Richpower Green products are :

- RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
- Suitable for use in SnPb or Pb-free soldering processes.

Marking Information

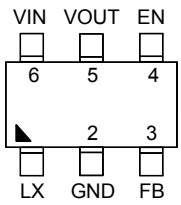
For marking information, contact our sales representative directly or through a Richpower distributor located in your area.

Applications

- WLED Flashlight
- Portable Devices

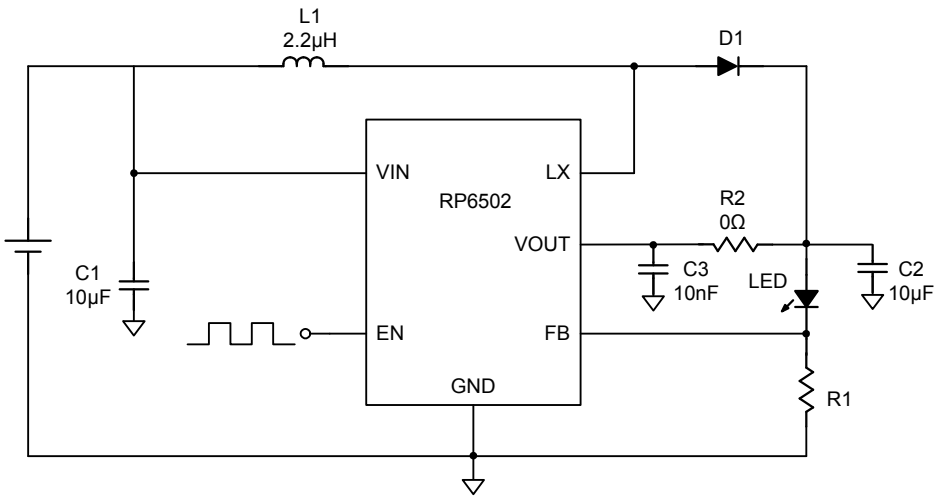
Pin Configurations

(TOP VIEW)



SOT-23-6

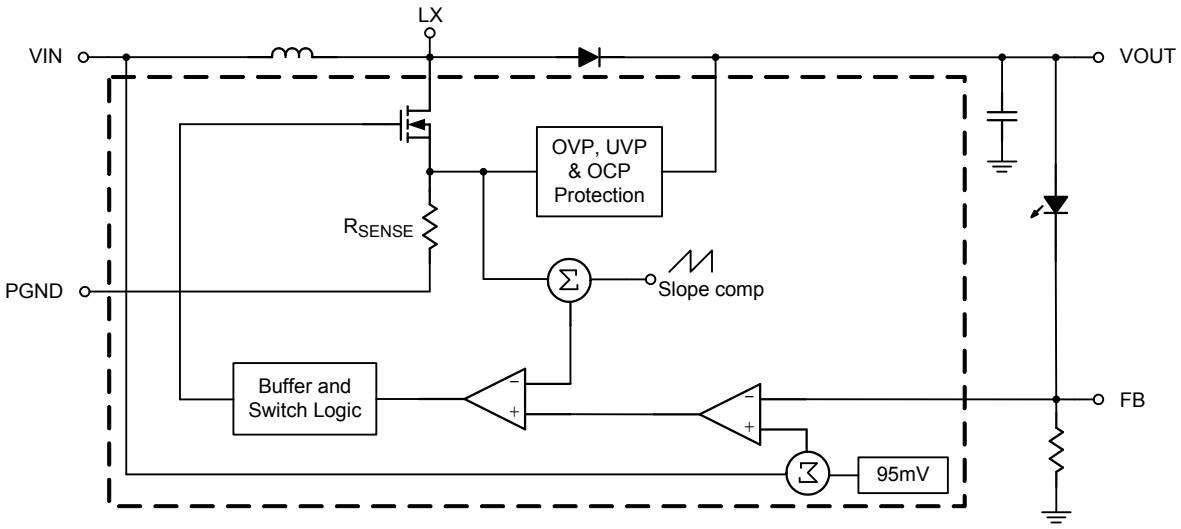
Typical Application Circuit



Functional Pin Description

Pin No.	Pin Name	Pin Function
1	LX	Connected to an Internal NMOS.
2	GND	Ground.
3	FB	Feedback.
4	EN	Enable. (If not in use, EN pin should be connected to VOUT.)
5	VOUT	Output Voltage.
6	VIN	Input Voltage.

Function Block Diagram



Absolute Maximum Ratings (Note 1)

- Supply Voltage (V_{IN}) ---------- 6V
- Output Voltage ---------- 6V
- Power Dissipation, P_D @ T_A = 25°C
  SOT-23-6 ---------- 0.4W
- Package Thermal Resistance (Note 2)
  SOT-23-6, θ_{JA} ---------- 250°C/W
- Junction Temperature ---------- 150°C
- Lead Temperature (Soldering, 10 sec.) ---------- 260°C
- Storage Temperature Range ---------- –65°C to 150°C
- ESD Susceptibility (Note 3)
  HBM (Human Body Mode) ---------- 2kV
  MM (Machine Mode) ---------- 200V

Recommended Operating Conditions (Note 4)

- Ambient Temperature Range ---------- –40°C to 85°C

Electrical Characteristics

(L = 2.2µH, C_{OUT} = 10µF, C_{IN} = 10µF, V_{OUT} = 3.6V, T_A = 25°C, unless otherwise specified.)

Parameter	Test Conditions	Min	Typ	Max	Units
Output Voltage Range		2.5	--	--	V
Startup Voltage	V_{IN} from 0V to 3V, I_{LED} = 300mA (Note 5)	--	0.7	--	V
Hold on Voltage	V_{IN} from 3V to 0V, I_{LED} = 300mA	--	0.3	--	V
Oscillator Frequency		700	850	1000	kHz
Maximum Duty		85	90	--	%
FB Voltage		90	95	100	mV
LX on Resistance		--	0.1	0.11	ohm
EN Pin Trip Level		0.4	0.8	1.2	V
Continuous Switching Current	FB = 0V	--	1	3	mA
Stand-by Current (VOUT)	Enable = 0V	--	--	100	µA
Over Current Protection	(Note 6)	2	--	--	A
Over Voltage Protection (VOUT)		4.5	5	5.5	V

Note 1. Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

Note 2. θ_{JA} is measured in the natural convection at T_A = 25°C on a low effective single layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

Note 3. Devices are ESD sensitive. Handling precaution recommended.

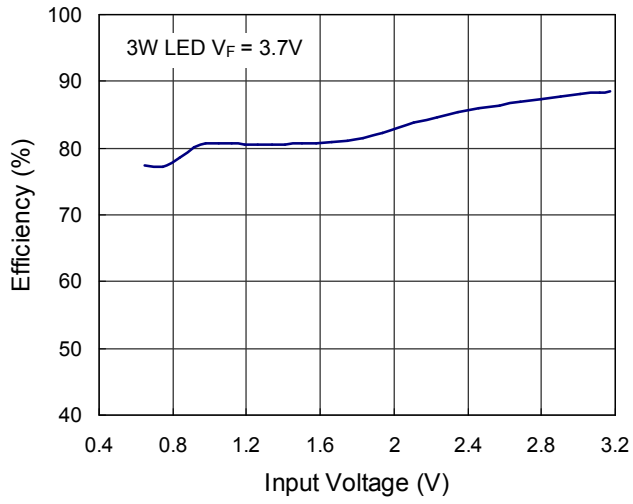
Note 4. The device is not guaranteed to function outside its operating conditions.

Note 5. I_{LED} is the preset LED current measured when V_{IN} = 3V.

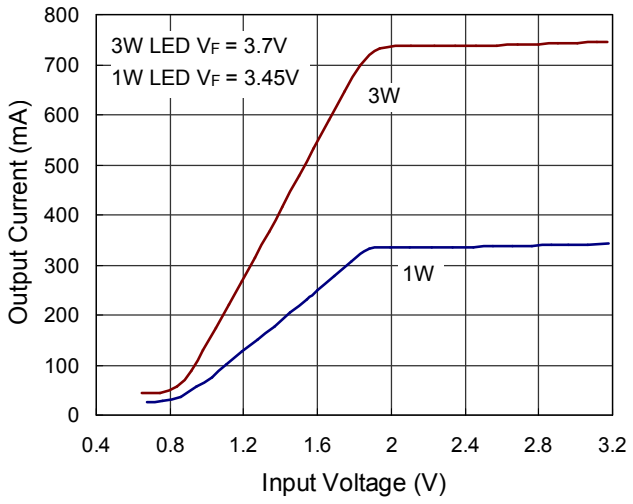
Note 6. Inductance Peak Current.

Typical Operating Characteristics

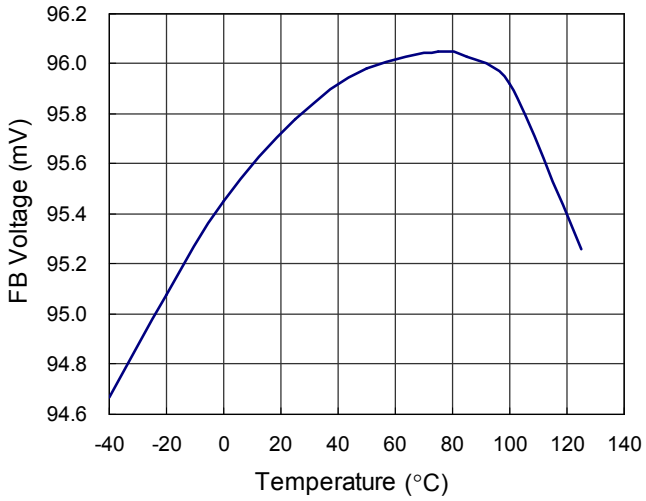
Efficiency vs. Input Voltage



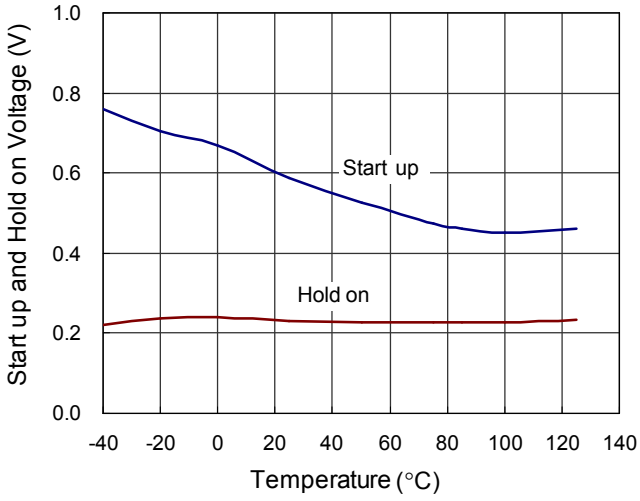
Output Current vs. Input Voltage



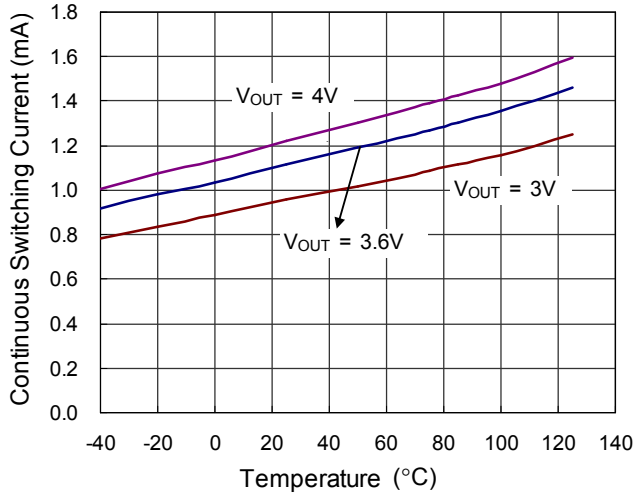
FB Voltage vs. Temperature



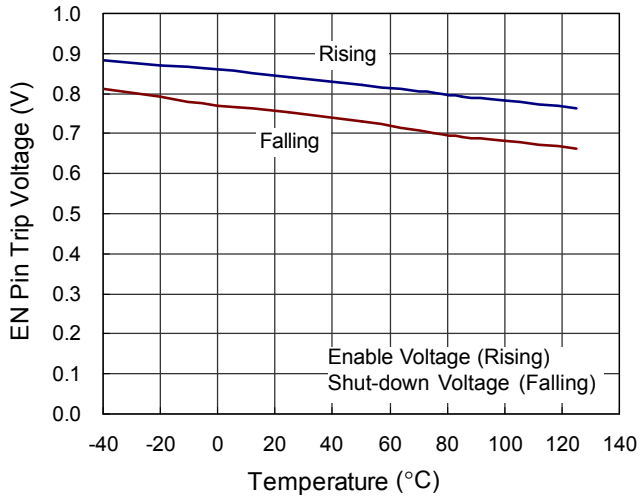
Start up and Hold on Voltage vs. Temperature



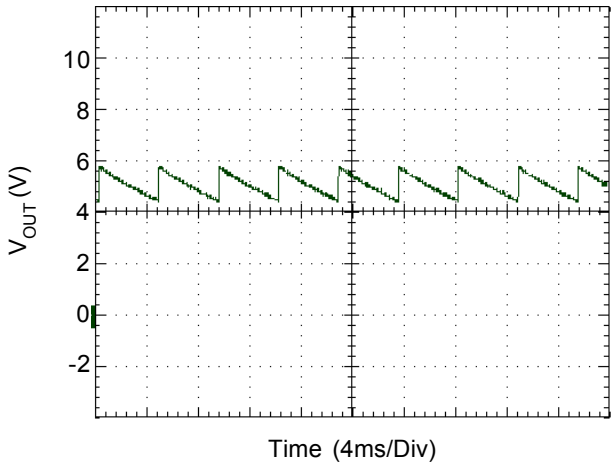
Continuous Switching Current vs. Temperature



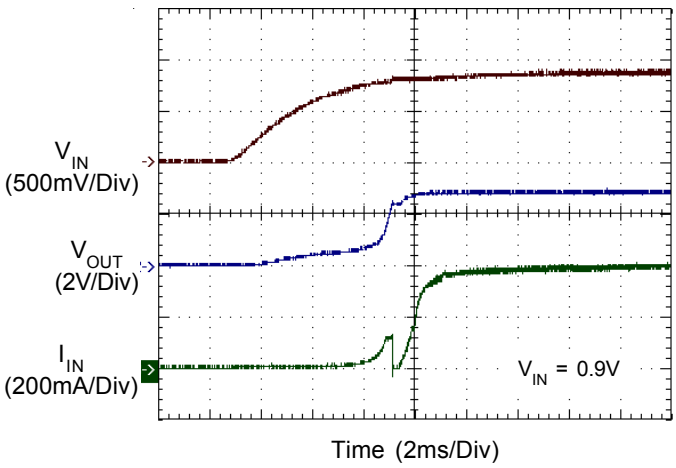
EN Pin Trip Voltage vs. Temperature



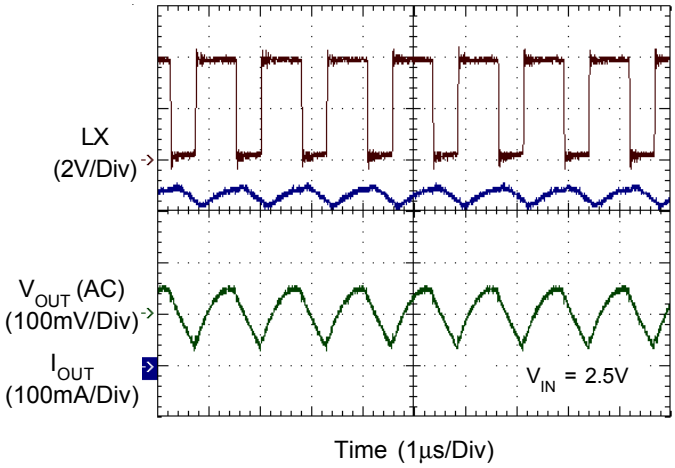
OVP



Power On



Switching



Applications Information

Capacitor Selection

Input and output ceramic capacitors of 10μF are recommended for RP6502 applications. For better voltage filtering, ceramic capacitors with low ESR are recommended. X5R and X7R types are suitable because of their wider temperature ranges.

To achieve accurate LED current control and cover different PCB layout, output RC filter is recommended. The maximum resistance and capacitor value of R2 and C3 used in output RC filter is 20ohm and 1μF. Typically values of R2 and C3 are 0ohm and 10nF respectively according to the PCB layout guideline.

Diode Selection

Schottky diode is a good choice for RP6502 because of its low forward voltage drop and fast reverse recovery.

Using Schottky diode can get better efficiency. The high-speed rectification is also a good characteristic of Schottky diode for high switching frequency. Current rating of the diode must meet the root mean square of the peak current and output average current multiplication as following:

$$I_D(RMS) \approx \sqrt{I_{OUT} \times I_{PEAK}}$$

The diode's reverse breakdown voltage should be larger than the output voltage. SS22 is recommended Schottky diode for rectifier.

Inductor Selection

The range of inductor for RP6502 applications is from 2.2μH to 22μH, and the recommended value is 2.2μH. For those applications which small size and better efficiency are the major concerns, such as portable device, the inductors should have low core loss at 850kHz and low DCR for better efficiency. The inductor saturation current rating should cover the inductor peak current.

LED Current Setting

The RP6502 regulates the LED current by setting the current sense resistor (R1) connected between FB and GND. The RP6502 feedback voltage (V_{FB}) is 95mV. The equation is as follows:

$$I_{LED}(mA) = 95(mV)/R1(ohm) \text{ at } V_{IN} = 3V$$

Typically, for 1W(350mA) and 3W(750mA) LED light applications, the R1 are 0.271ohm and 0.127ohm respectively. In order to have an accurate LED current, a precise resistor is preferred (1% is recommended).

Low Voltage Startup and Soft Start

The RP6502 has a build-in low voltage startup circuit for the best battery life solution. It can start up at 0.7V V_{IN} typically when the preset LED current is 300mA (Note 5).

The soft-start function is made by clamping the output voltage of error amplifier with another voltage source which increases slowly from zero to near VIN during the soft-start period. Therefore, the duty cycle of the PWM will be increased from zero to maximum in this period. The charging time of the inductor will be limited by the smaller duty so that the inrush current can be reduced to an acceptable value.

Over Voltage Protection

The output voltage of RP6502 is monitored by Over Voltage Protection circuit. Once V_{OUT} goes over V_{OVP}, typically 5V, the power NMOS is turned off and LX pin stops switching. Then, the V_{OUT} is clamped to around V_{OVP}.

Over Current Protection

The inductor current during charging period is detected by a current sensing circuit. When the value is larger than current limiting I_{LIM}, the power NMOS is turned off so that the inductor will be forced to leave charging stage and enter discharging stage. Therefore, the inductor peak current will not exceed I_{LIM}, whose minimum value is 2A.

PCB Layout Guide

- A Full GND plane without gap break.
- The trace of the current path should be kept as short and wide as possible.
- The output capacitor C2 should be connected directly from the cathode of the Diode D1 to Pin 2. (*1)
- Output RC filter: Short and wide connection for the 0.1μF MLCC capacitor between Pin 2 and Pin 5. The GND of filter capacitor C3 should be connected to the GND away form the current path. (*2)
- LED should be connected directly from cathode of the Diode D1 and Pin 3. (*3)
- The FB resistor should be placed as close as RP6502. (*4)

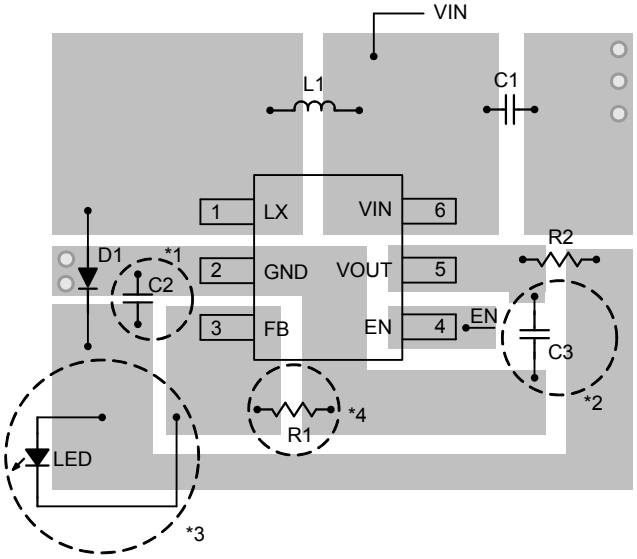
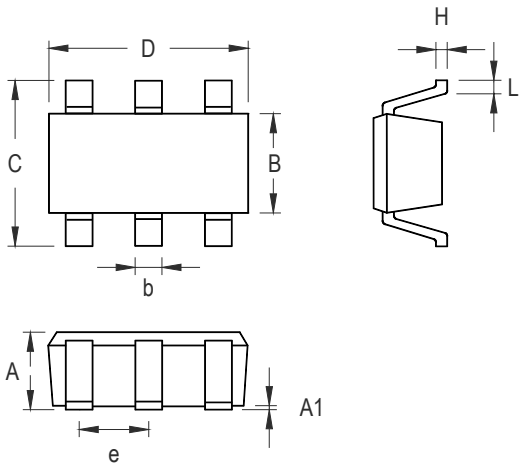


Figure 1. Top

Figure 2. Bottom

Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.889	1.295	0.031	0.051
A1	0.000	0.152	0.000	0.006
B	1.397	1.803	0.055	0.071
b	0.250	0.560	0.010	0.022
C	2.591	2.997	0.102	0.118
D	2.692	3.099	0.106	0.122
e	0.838	1.041	0.033	0.041
H	0.080	0.254	0.003	0.010
L	0.300	0.610	0.012	0.024

SOT-23-6 Surface Mount Package

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