

High Efficiency, Constant Current, Boost DC/DC White-LEDs Drive

Features

- Operating Voltage : 4.5V to 7.5V
- High Operating Frequency : 1MHz
- High Output Voltage : 40V
- Shutdown Current : <math><1\mu\text{A}</math>
- Over-Voltage Protection
- Digital Dimming Control
- Built-in Cycle-by-Cycle Current-Limiting
- Soft-Start Function
- 0.3V Low Reference Voltage
- Tiny SOT-23-6 and MSOP-8 Package

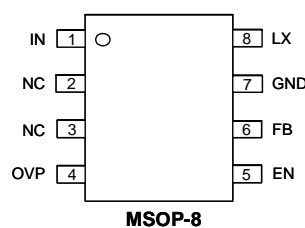
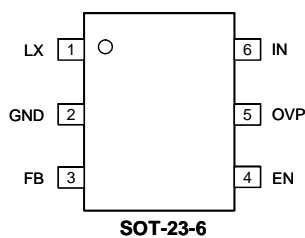
Applications

- LED Module
- Compact Back Light Module
- Constant Current Source

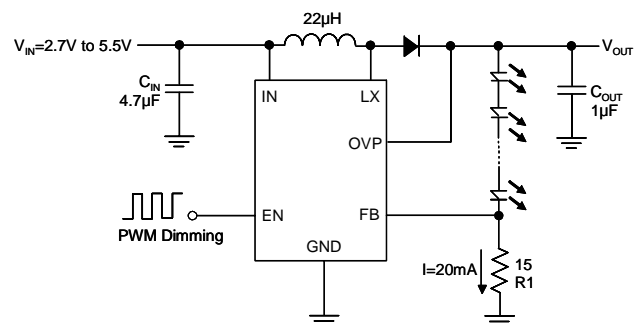
General Description

The ZCC9293 boost converter contains a 0.7Ω internal switch. The IC operates at constant frequency 1MHz, allowing the use of tiny, low cost and low height inductors and capacitors. The IC operates from a 4.5V to 7.5V supply voltage. High inrush current at start-up is eliminated using the soft-start function. Constant frequency current mode PWM architecture results in low, predictable output noise. The IC includes cycle-by-cycle 600mA current limiting to maximum inductor current and over-temperature protection circuit. The over-voltage protection will be enabled when VOUT exceeds 40V. The current of LED is set by a resistor connected between FB and GND. The ZCC9293 is available in SOT-23-6 package.

Pin Configuration



Typical Application Circuit



ZCC9293

Absolute Maximum Ratings

IN to GND.	-0.3V to 7.5V	Operating Temperature Range ¹	-40°C to +85°C
LX, OVP to GND.	-0.3V to 45V	Junction Temperature	+150°C
EN to GND.	-0.3V to VIN	Storage Temperature	-65°C to +150°C
FB to GND.	-0.3V to VIN	Reflow Temperature (soldering, 10sec)	260°C

Note:

1. It is guaranteed to meet performance specifications from 0°C to 85°C. Specifications over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

Electrical Characteristics

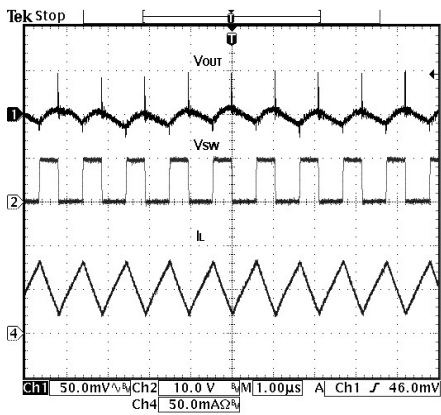
$V_{IN}=V_{EN}=3.6V$, $T_A = 25^\circ C$.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Input Voltage		4.5		7.5	V
Over-voltage Threshold		---	40	---	V
Over-voltage Hysteresis		---	5	---	V
Quiescent Current	No Switching	---	0.2	0.4	mA
Shutdown Supply Current	EN=0V	---	0	1	μA
EN Input Level	V_{IH}	1.5	---	---	V
	V_{IL}	---	---	0.8	V
$UVLO_{RISING}$		2	2.25	2.5	V
Oscillator Frequency		---	1	---	MHz
Maximum Duty Cycle		---	90	---	%
Feedback Regulation Voltage		0.28	0.3	0.32	V
NMOS R_{DS-ON}	$I_{LX}=200mA$	---	700	---	$m\Omega$
LX Leakage Current	EN=0, $V_{LX}=45V$	---	---	10	μA
Switching Current Limit	$V_{IN}=3.0V$, duty cycle=80%	---	600	---	mA
Over Temperature	Trigger	---	120	---	$^\circ C$
	Hysteresis	---	20	---	$^\circ C$
Soft Start		---	0.5	---	ms

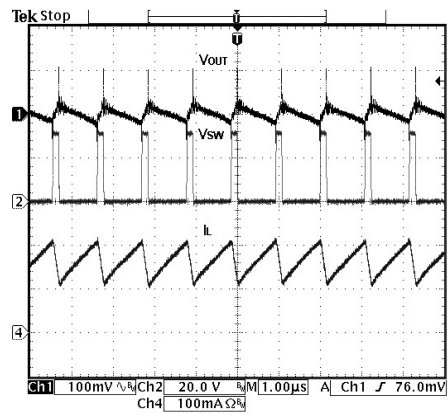
Typical Performance Characteristics

($V_{CC} = +4.5V$, $V_{EN} = +4.5V$, $L = 47\mu H$, $T_A = 25^\circ C$, unless otherwise noted.)

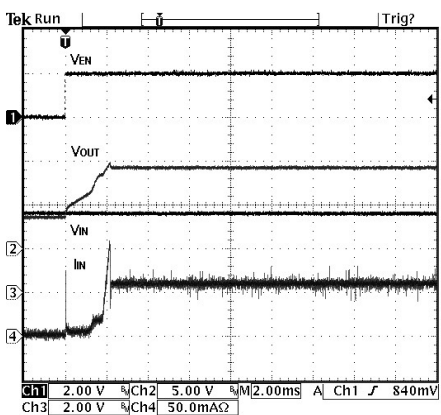
Stability Waveform-3 LEDs



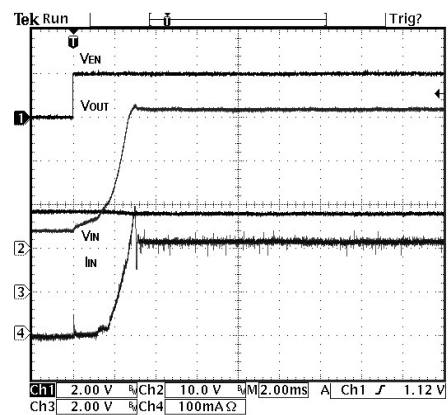
Stability Waveform-10 LEDs



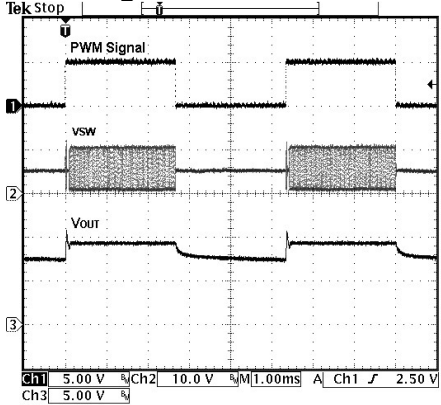
Inrush Current Waveform-3 LEDs



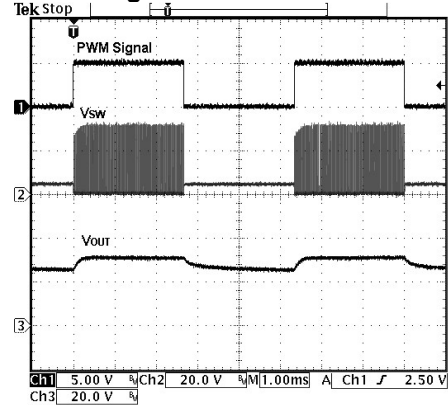
Inrush Current Waveform-10 LEDs



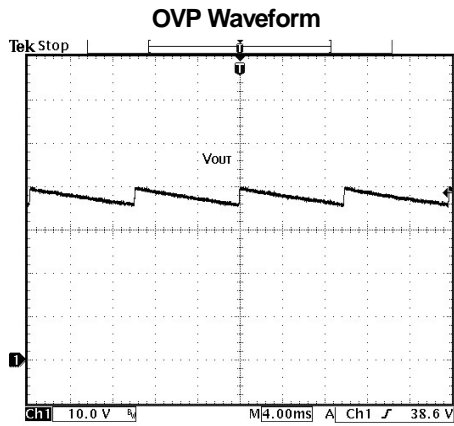
Dimming Control Waveform-3 LEDs



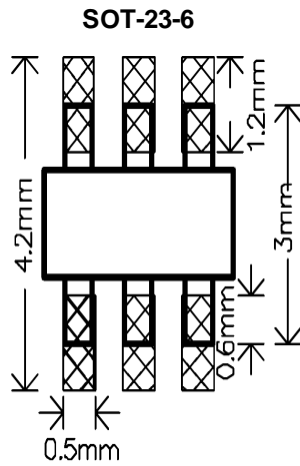
Dimming Control Waveform-10 LEDs



Typical Performance Characteristics (Continued)



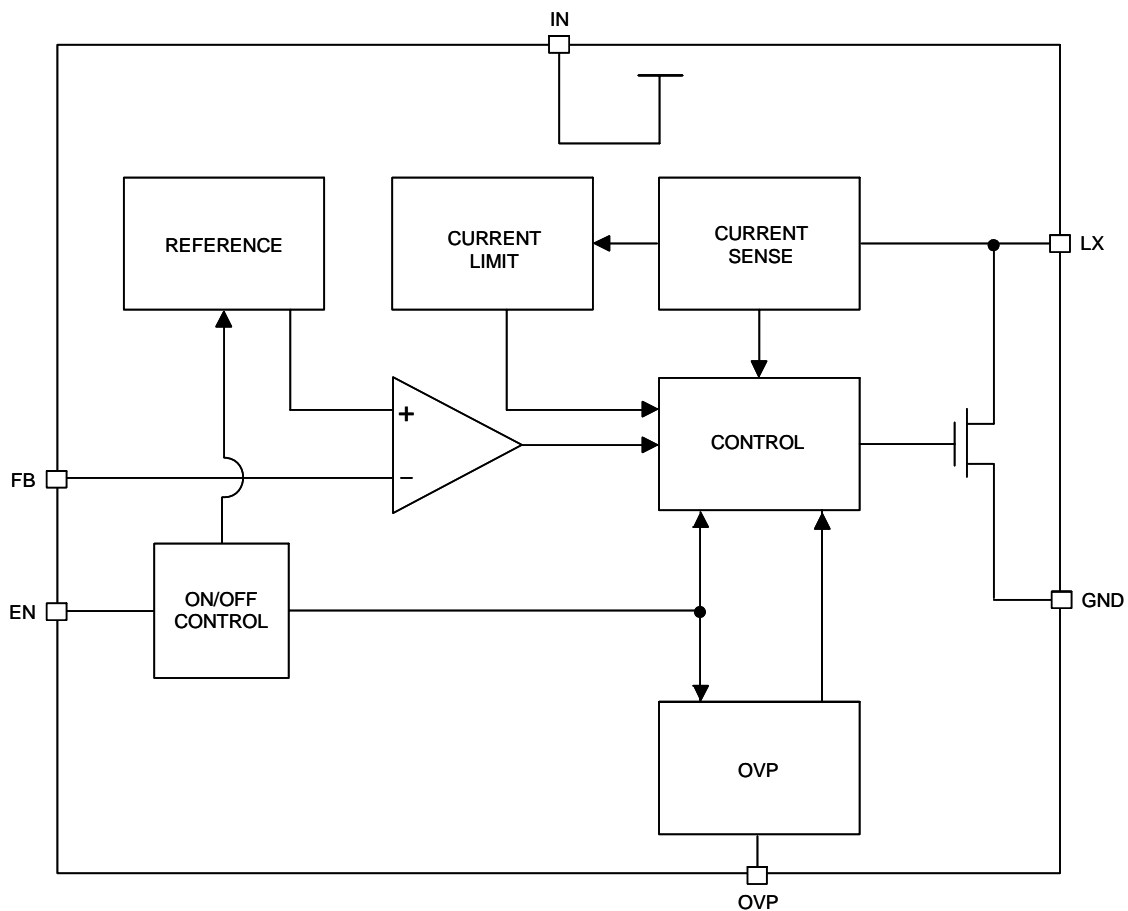
Recommended Minimum Footprint



Pin Descriptions

PIN		Name	FUNCTION
SOT-23-6	MSOP-8		
1	8	LX	Power Switching Output
2	7	GND	Ground Pin.
3	6	FB	Feedback Input.
4	5	EN	Enable Input. Drive EN high to turn on the regulator, drive it low to turn it off.
5	4	OVP	Over-voltage protection input. Connect to the output.
6	1	IN	Power Input Pin. It must be bypassed with a low-ESR capacitor.
	2,3	NC	

Block Diagram



Operating

The ZCC9293 step-up DC-DC converter operates from a 3.0V to 6.5V supply. The device includes an internal switching MOSFET with a 0.7Ω on-resistance and consumes $200\mu\text{A}$ of supply current. During startup, the ZCC9293 limits the maximum on-time to limit initial battery inrush current. Adjusting the output voltage by changing the resistance of R1 and the number of LEDs that connect in series from VOUT to FB the output voltage may up to 40V. For driving 9~10 LEDs series application, the V_{IN} should be greater than 3.6V. The current of LED is set by the resistor R1 which connect from FB to GND. The current equals to voltage of FB (0.3V) to divide the resistance of R1. The ZCC9293 built in a cycle-by-cycle 600mA current-limit function to maximum inductor current. The ZCC9293 consumes $0.1\mu\text{A}$ when voltage of EN is Low. The over-voltage protection is included.

Application Information

Inductor Selection

The inductor's saturation current rating should be greater than the peak switching current. The large inductance prevents the large inductor's current ripple to induce maximum current limit in on-time period and output voltage ripple can be reduced also. Inductor with low core losses and small DCR (cooper wire resistance) is recommended.

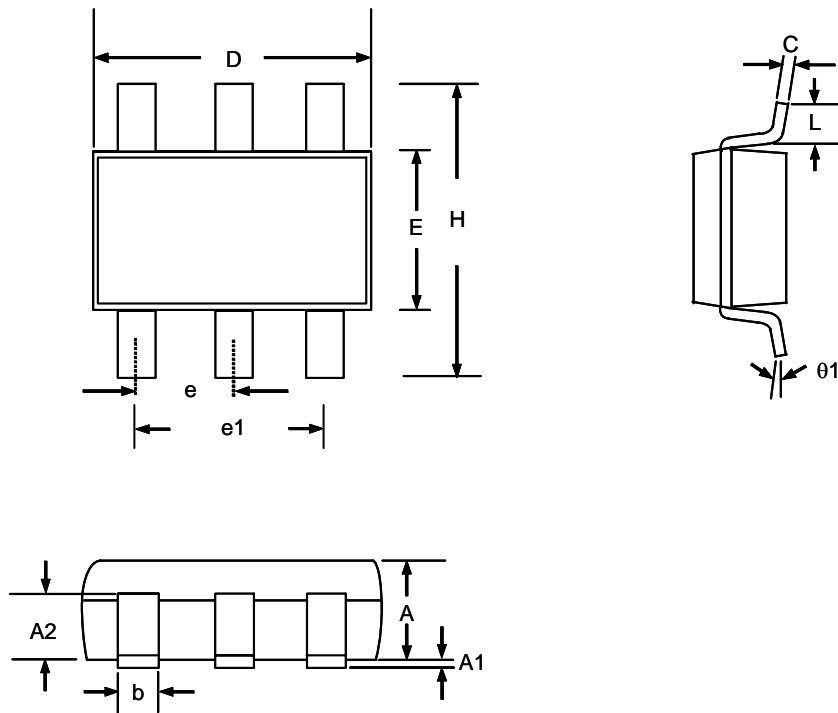
Capacitor Selection

The small size of ceramic capacitors makes them suitable for ZCC9293 applications. X5R and X7R types are recommended because they retain their capacitance over wider voltage and temperature ranges than other types such as Y5V or Z5U. A minimum $1\mu\text{F}$ capacitor for output is required for most applications. Larger input/output capacitor minimizes input/output ripple.

Diode Selection

Schottky diodes, with their low forward voltage drop and fast reverse recovery, are the ideal choices for ZCC9293 applications. The forward voltage drop of a Schottky diode represents the conduction losses in the diode, while the diode capacitance (C_T or C_D) represents the switching losses. For diode selection, both forward voltage drop and diode capacitance need to be considered. Schottky diodes with higher current ratings usually have lower forward voltage drop and large diode capacitance, which can cause significant switching losses at the 1MHz switching frequency of the ZCC9293.

Package Information



SOT-23-6 Package

Note:

1. Package body sizes exclude mold flash protrusions or gate burrs
2. Tolerance ± 0.1000 mm (4mil) unless otherwise specified
3. Coplanarity: 0.1000mm
4. Dimension L is measured in gage plane

SYMBOL	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.00	1.10	1.30	0.039	0.043	0.051
A1	0.00	-----	0.10	0.000	-----	0.004
A2	0.70	0.80	0.90	0.028	0.031	0.035
b	0.35	0.40	0.50	0.014	0.016	0.020
C	0.10	0.15	0.25	0.004	0.006	0.010
D	2.70	2.90	3.10	0.106	0.114	0.122
E	1.40	1.60	1.80	0.055	0.063	0.071
e	-----	0.95	-----	-----	0.037	-----
e1	-----	1.90 (TYP)	-----	-----	0.075 (TYP)	-----
H	2.60	2.80	3.00	0.102	0.110	0.118
L	0.37	-----	-----	0.015	-----	-----
$\theta 1$	1°	5°	9°	1°	5°	9°