BL8549

40V Backlight LED Driver with PWM Direct Dimming

DESCRIPTION

The BL8549 is a high efficiency current-mode asynchronous, 40V boost converter for LED backlight driving. Its input voltage ranges from 2.5V to 4.5V and it provides an adjustable constant current output decided by the Rset connected to BL8549's FB pin. The LED brightness can also be controlled by a PWM signal directly set to CE pin, making dimming control very simple.

The BL8549's switching frequency is set to 600KHz, and it will automatically switch between PFM and PWM mode based on the load current, thus to enhance the converter efficiency at light load as well as heavy load.

BL8549 consists of many protection blocks such as UVLO, output voltage over voltage protection, and thermal protection to keep the chip and load safe under unexpected environment.

The BL8549 is available in the tiny DFN2x2-6 and SOT23-6 package.

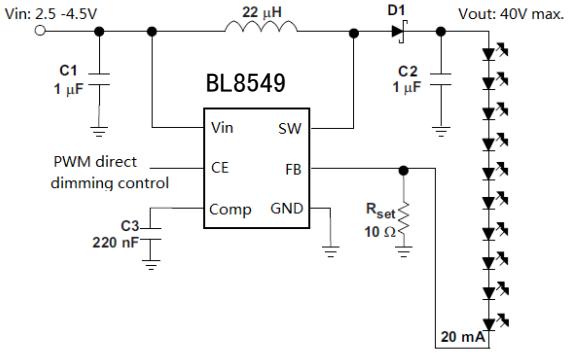
FEATURES

- Adjustable Output Voltage, Vfb=0.2V
- Output voltage 40V, driving up to 12 LED string
- Range of operation input voltage: 2.5 – 4.5V
- Output Overvoltage Protection @40V
- CE pin PWM direct dimming function
- Line regulation: 0.1%/V (typ.)
- Load regulation: 10mV (typ.)
- High efficiency, up to 90% in driving 10 LEDs
- Environment Temperature: -20°C~85°C

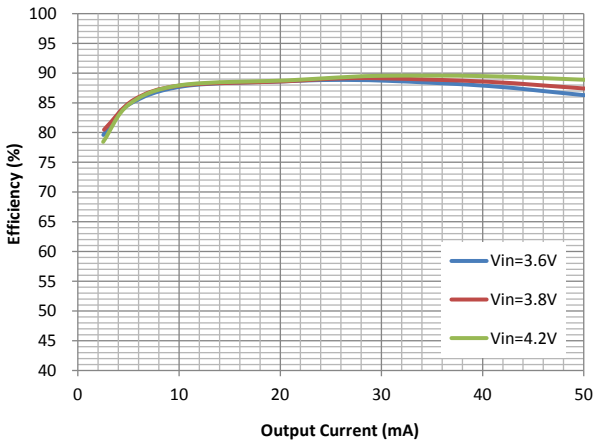
APPLICATIONS

- Smartphone
- 7" MID
- Portable DVD
- TFT LCD bias
- Portable LED lighting or torch
- Other application need high voltage

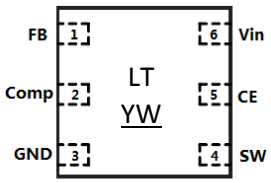
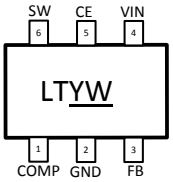
TYPICAL APPLICATION and PIN OUT



Efficiency for Driving 10 LEDs



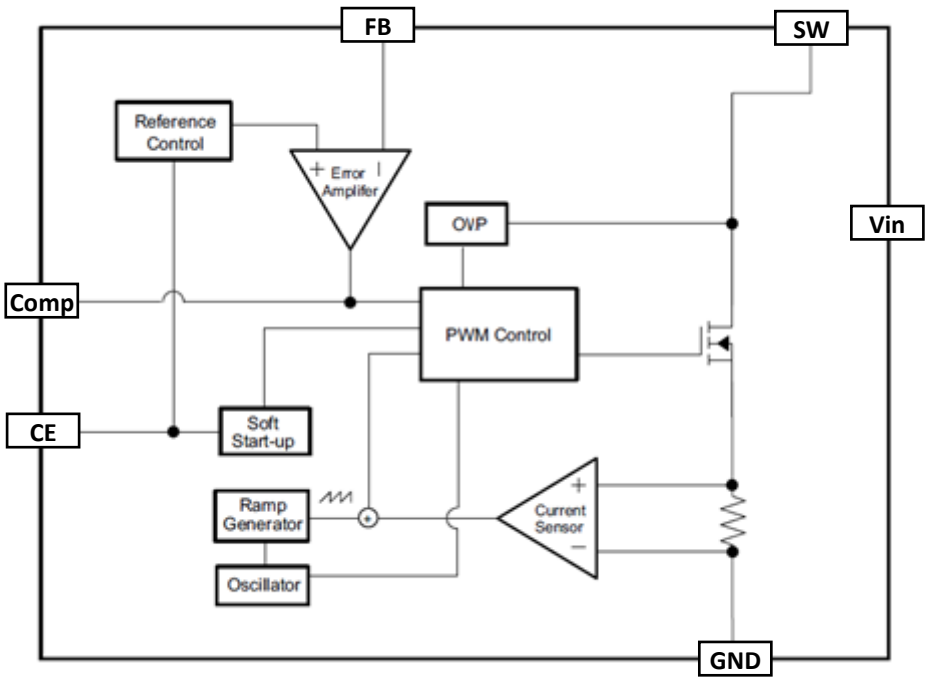
PACKAGE, MARK and ORDERING INFORMATION

Package DFN2x2-6	Mark Explanation	Ordering Information	Package SOT23-6	Mark Explanation	Ordering Information
 DFN2x2-6	LT: Product Code	Product ID: BL8549CKCTR	 SOT23-6	LT: Product Code	Product ID: BL8549CB6TR
	YW: Date Code	Devices/Reel: 3000		YW: Date Code	Devices/Reel: 3000

PINOUT DESCRIPTION

NAME	PIN #		DESCRIPTION
	DFN2x2-6	SOT23-6	
FB	1	3	Feedback input with reference voltage set to 0.2V
Comp	2	1	Compensation pin, to connect a 220nF capacitor to make loop stable.
GND	3	2	Ground.
SW	4	6	Power switching node to connect inductor
CE	5	5	Chip enable, but a PWM signal with various duty cycle can directly sent to CE pin to achieve the backlight dimming
VIN	6	4	Power input, 1uf input capacitor is recommended.

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATING

Parameter		Value
Max Input Voltage		5.5V
Max Output Voltage (SW pin)		40V
Max Operating Junction Temperature(Tj)		125°C
Ambient Temperature(Ta)		-20°C – 85°C
Package Thermal Resistance	DFN2x2-6 (θ_{JC})	20°C / W
	DFN2x2-6 (θ_{JA})	140°C / W
Storage Temperature(Ts)		-40°C - 150°C
Lead Temperature & Time		260°C, 10S
ESD (HBM)		>2000V

Note: Exceed these limits to damage to the device. Exposure to absolute maximum rating conditions may affect device reliability.

RECOMMENDED WORK CONDITIONS

Parameter	Value
Input Voltage Range	2.5V – 4.5V
Operating Junction Temperature(Tj)	-20°C –125°C

ELECTRICAL CHARACTERISTICS

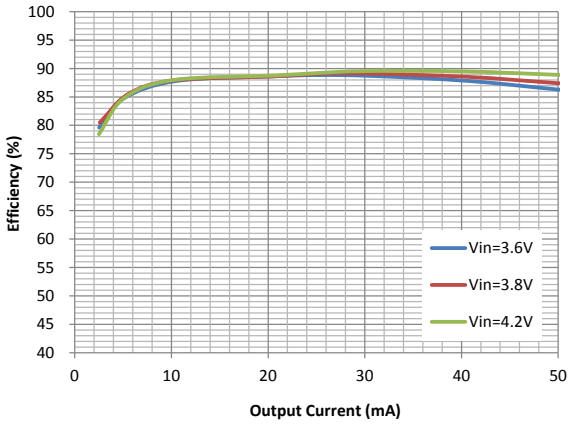
(VIN=12V, T_A=25°C)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Vin	Input Voltage Range		2.5		4.5	V
Vref	Feedback Voltage	Vin=3.6V, Vce=Vin	0.190	0.200	0.210	V
V_{UVLO}	UVLO Voltage	Vin H-->L, Iout=0.5A		2.5		V
Ifb	Feedback Leakage current			0.1	0.4	uA
Iq	Quiescent Current	Active, Vfb=1V, No Switching		0.6	1.0	mA
		Shutdown, Vin=3.6V		1	5	uA
LnReg	Line Regulation	Vin=2.5V to 4.5V		0.1		%/V
Fsoc	Switching Frequency	Vin=Vce=3.6V	450	600	750	KHz
RdsonH	Low side Switch Rdson	Isw=200mA		300	500	mohm
Ilimit	Peak Inductor Current Limit	Vin=3.6V, Vout=32V	0.8	1	1.4	A
Vceh	CE High Threshold		1	1.5	3	V
Vcel	CE Low Threshold				0.3	V
Vovp	Output Over-Voltage Protection	Vce=3.6V	40	42		V
TSD	Over Temperature Proection	Hystersis=40°C		150		°C
Toff	CE pin pulse width to shutdown	CE high to low	2.5			ms
Fpwm_CE	CE PWM dimming frequency		10	50		KHz

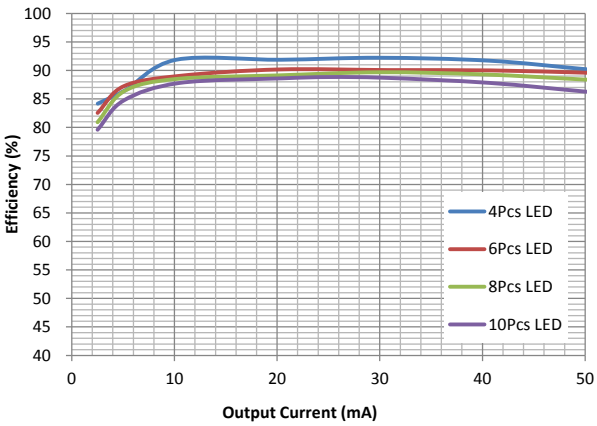
TYPICAL PERFORMANCE CHARACTERISTICS

(Vin=3.6V, L=22uH, Cin=1uF, Cout=1uF, T_A=25°C, unless otherwise stated)

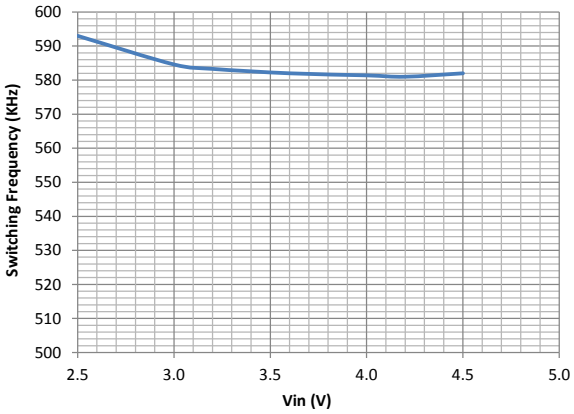
Efficiency VS Iout for 10 LEDs



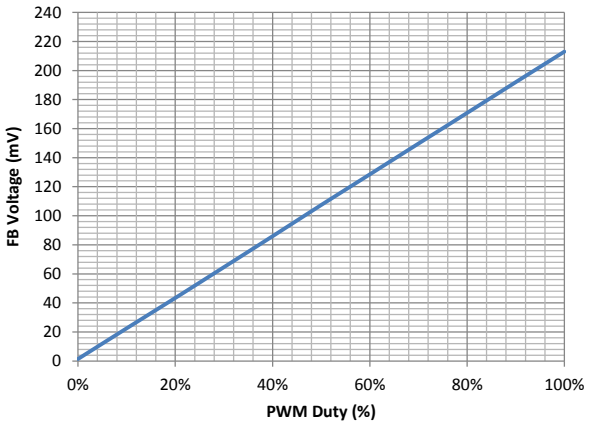
Efficiency VS Output Current



Frequency Vs. Vin for 10 LEDs

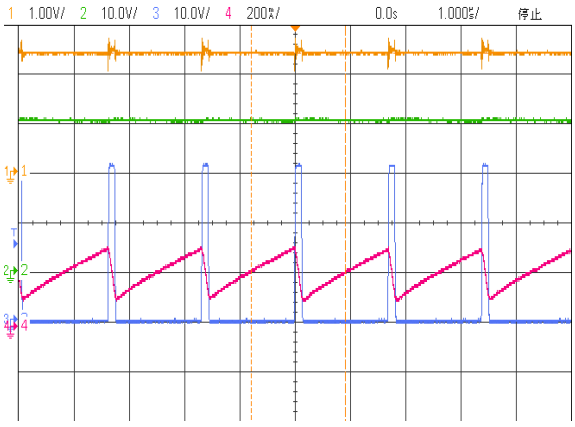


FB Voltage Vs. PWM Duty Cycle



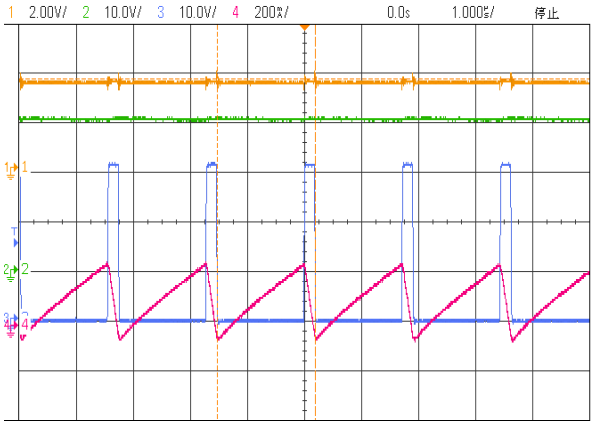
Switching waveform Vin=2.5V, 10 LEDs

(CH1=Vin, CH2=Vout, CH3=SW, CH4=Isw)



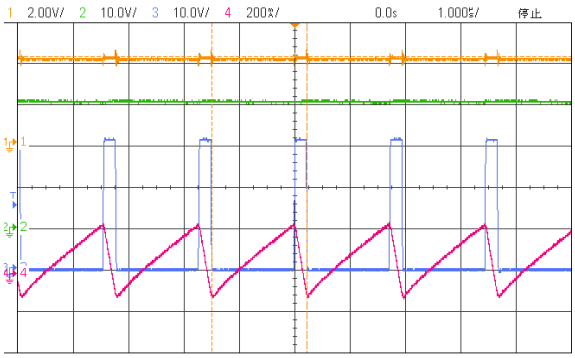
Switching waveform Vin=3.6V, 10 LEDs

(CH1=Vin, CH2=Vout, CH3=SW, CH4=Isw)



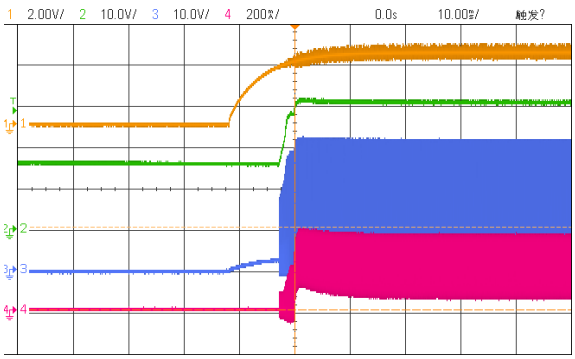
Switching waveform Vin=4.2V, 10 LEDs

(CH1=Vin, CH2=Vout, CH3=SW, CH4=Isw)



Startup waveform Vin=3.6V, 10 LEDs

(CH1=Vin, CH2=Vout, CH3=SW, CH4=Isw)



FUNCTIONAL DECRIPTIONS

Loop Operation

The BL8549 is a high voltage, high-efficiency, DC-to-DC step-up LED driver, capable of driving up to 10 LEDs. It integrates with a 300mΩ MOSFET, with external schottky diode. It uses a PWM current-mode control scheme. An error amplifier integrates error between the FB signal and the internal reference voltage. The output of the integrator is then compared to the sum of a current-sense signal and the slope compensation ramp. This operation generates a PWM signal that modulates the duty cycle of the power MOSFETs to achieve regulation for output voltage.

Current Limit

There is a cycle-by-cycle current limit on the high-side MOSFET of 1A(typ). When the current flowing out of SW exceeds this limit, the low-side MOSFET turns off and the external schottky diode rectifier turns on. Unlike the traditional method of current limiting by limiting the voltage at the external compensation node, which usually has large variation due to duty cycle variance, this type of peak current limiting scheme provides a relatively more accurate limit for output current, thereby lowering the requirements for system design.

Light Load Operation

Traditionally, a fixed current mode constant frequency PWM DC-DC regulator always switches even when the output load is small. When energy is shuffling back and forth through the power MOSFETs, power is lost due to the finite RDSONs of the MOSFETs and parasitic capacitances. At light load, this loss is prominent and efficiency is therefore very low. BL8549 employs a proprietary control scheme that improves efficiency in this situation by enabling the device into a power save mode during light load, thereby extending the range of high efficiency operation.

PWM BRIGHTNESS DIMMING CONTROL at CE PIN

When CE pin is forced a PWM signal with frequency higher than 5KHz, the chip is in dimming mode. The internal circuit changes the feedback voltage according to the duty cycle of the PWM signal. The feedback voltage (Vfb) is simply defined as below:

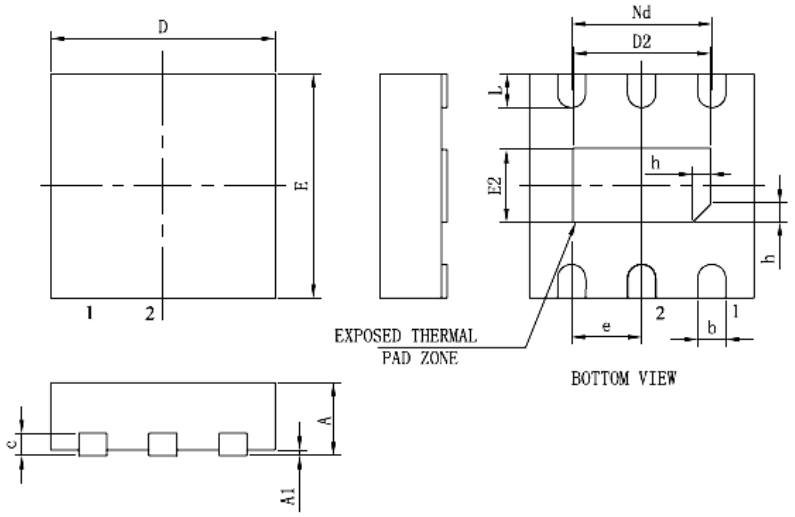
Vfb=200mV x Duty Cycle (%)

To shut down the chip, one has to make the CE signal low, and keep its low state for more than 2.5ms.

PACKAGE OUTLINE

Package	DFN2x2-6	Devices per reel	3000	Unit	mm

Package specification：



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	—	0.02	0.05
b	0.25	0.30	0.35
c	0.18	0.20	0.25
D	1.95	2.00	2.05
D2	1.00	—	1.45
e	0.65BSC		
Nd	1.30BSC		
E	1.95	2.00	2.05
E2	0.50	—	0.85
L	0.25	0.30	0.40
h	0.10	0.15	0.20

Package	SOT23-6	Devices per reel	3000	Unit	mm

Package specification：