BCT3692B

Preliminary

Small Package, High Performance, Asynchronies Boost for 12 WLED Driver

General Description

The BCT3692B is a high frequency, asynchronous boost converter. The internal MOSFET can support up to 12 White LEDs for backlighting and OLED power application, and the internal soft start function can reduce the inrush current. The device operates with 600kHz fixed switching frequency to allow small external components and to simplify possible EMI problems. For the protection, the BCT3692B provides up to 50V OVP to allow inexpensive and small-output capacitors with lower voltage ratings. The LED current is initially set with the external sense resistor RSET. The BCT3692B is available in the tiny package type SOT23-6 packages to save PCB space.

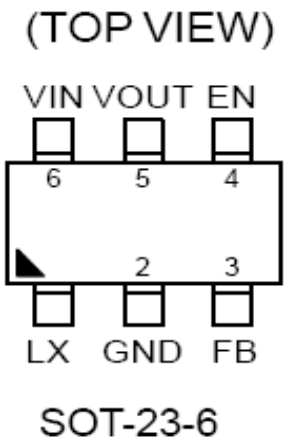
Features

VIN Operating Range : 3.0V to 5.5V
Internal Power N-MOSFET Switch
Wide Range for PWM Dimming (10kHz to100kHz)
Minimize the External Component Counts
Internal Soft Start
Internal Compensation
Under Voltage Protection
Small TSOT-23-6 Packages
RoHS Compliant and Halogen Free

Applications

Cellular Phones
Digital Cameras
PDAs，Smart Phones，MP3 and OLED.
Portable Instruments

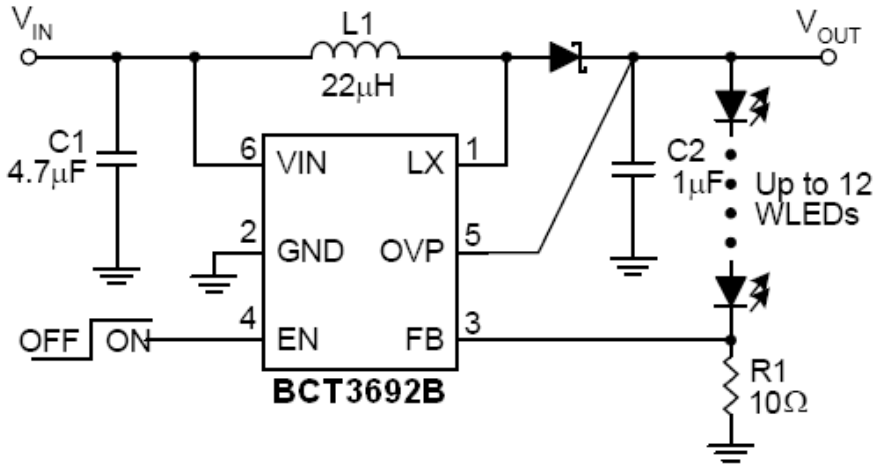
Pin Configurations



ORDERING INFORMATION

PART	PIN-PACKAGE	Temp-Range	Top Mark	Supplied as:
BCT3692BEUT-TR	SOT23-6	-40°C to +85°C	DDS	3000units/Tape & Reel

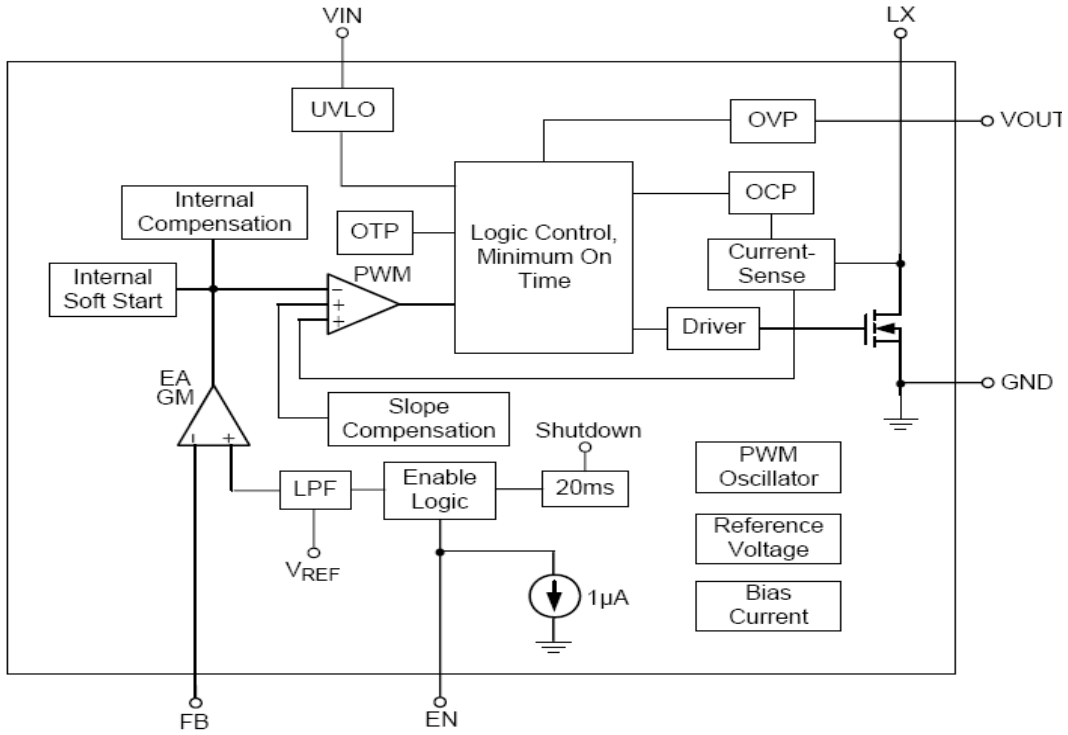
Typical Application Circuit



Functional Pin Description

1	LX	Switching Pin.
2	GND	Ground Pin.
3	FB	Feedback Pin, Connect the sense resistor from FB to GND.
4	EN	Chip Enable (Active High).
5	VOUT	Output Voltage Pin.
6	VIN	Input Supply.

Function Block Diagram



Absolute Maximum Ratings (Note 1)

Supply Input Voltage, VIN	−0.3V to 6V
Switching Pin, LX	−0.3V to 50V
VOUT	−0.3V to 46V
Other Pins	−0.3V to 6V
Power Dissipation, PD @ TA = 25°C	
TSOT-23-6	0.392W
Package Thermal Resistance (Note 2)	
TSOT-23-6, θJA	255°C/W
Lead Temperature (Soldering, 10 sec.)	260°C
Junction Temperature	150°C
Storage Temperature Range	−65°C to 150°C

Recommended Operating Conditions (Note 3)

Junction Temperature Range	−40°C to 125°C
Ambient Temperature Range	−40°C to 85°C

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.

θJA is measured in the natural convection at TA = 25°C on a low effective single layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard. The case point of θJC is on the expose pad for the WDFN package.

Note 3.

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

Electrical Characteristics

(VIN = 3.7V, CIN = 2.2μF, COUT = 0.47μF, IOUT = 20mA, L = 22μH, TA = 25°C, unless otherwise specified)

Parameter		Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage		VIN		3.0	--	5.5	V
Supply Current		IIN	FB = 0V, Switching	--	1	2	mA
Shutdown Current		ISHDN	VEN < 0.4V	--	1	4	μA
Line Regulation			VIN = 3 to 4.3V	--	1	--	%
Load Regulation			1mA to 20mA	--	1	--	%
Operation Frequency		fOSC		480	600	720	kHz
Maximum Duty Cycle				90	92	--	%
Clock Rate				10	--	100	kHz
Feedback Reference Voltage		VREF		190	200	210	mV
On Resistance		RDS(ON)		--	0.5	1.0	Ω
EN Threshold Voltage	Logic-High	VIH		1.4	--	--	V
	Logic-Low	VIL		--	--	0.5	
EN Sink Current		IIH		--	0.1	--	μA
EN Hysteresis				--	0.1	--	V
Over-Voltage Threshold		VOVP		48	50	52	V
Over-Current Threshold (Max Dyty)		IOCP		0.6	0.8	1	A
Shutdown Delay		TSHDN		--	1	--	ms

Applications Information

LED Current Setting

The loop of Boost structure will keep the FB pin voltage equal to the reference voltage V_{REF}. Therefore, when R_{SET} connects FB pin and GND, the current flows from V_{OUT} through LED and R_{SET} to GND will be decided by the current on R_{SET}, which is equal to following equation :

$$I_{LED} = V_{FB} / R_1 \qquad (1)$$

Dimming Control

For the brightness dimming control of the BCT3692B, the IC provides typically 200mV feedback voltage when the EN pin is pulled constantly high. However, EN pin allows a PWM signal to reduce this regulation voltage by changing the PWM duty cycle to achieve LED brightness dimming control. The relationship between the duty cycle and FB voltage can be calculated as following equation :

V_{FB} = Duty x 200mV

Where

Duty = duty cycle of the PWM signal

200mV = internal reference voltage

As shown in Figure 1, the duty cycle of the PWM signal is used to cut the internal 300mV reference voltage. An internal low pass filter is used to filter the pulse signal. And then the reference voltage can be made by connecting the output of the filter to the error amplifier for the FB pin voltage regulation.

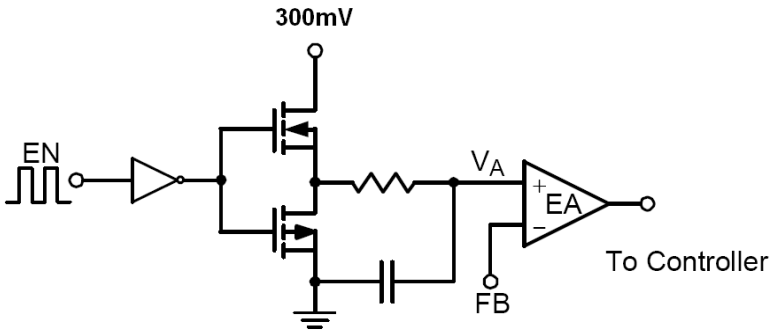


Figure 1. Block Diagram of Programmable FB Voltage Using PWM Signal

However, the internal low pass filter 3db frequency is 500Hz. When the dimming frequency is lower then 500Hz, V_A is also a PWM signal and the LED current is controlled directly by this signal. When the frequency is higher than 500Hz, PWM is filtered by the internal low pass filter and the V_A approach a DC signal. And the LED current is a DC current which eliminate the audio noise. PWM Dimming from EN are shown in Typical Operating Characteristics section and the PWM dimming frequency is form 10kHz to 100kHz respectively. But there is an offset in error amplifier which will cause the V_A variation. For the BCT3692B, the minimum duty vs frequency is listed in following table.

	Duty Minimum
Dimming frequency < 500Hz	4%
Dimming frequency > 500Hz	10%

Application for driving more string WLEDs

The BCT3692B can drive different WLEDs topology. For example, the Figure 2 shows the 3x8 WLEDs and total current is equal to 160mA. The total WLEDs current can be set by the R_{SET} which is equal to following equation:

$I_{Total} = V_{REF}/R_{SET}$

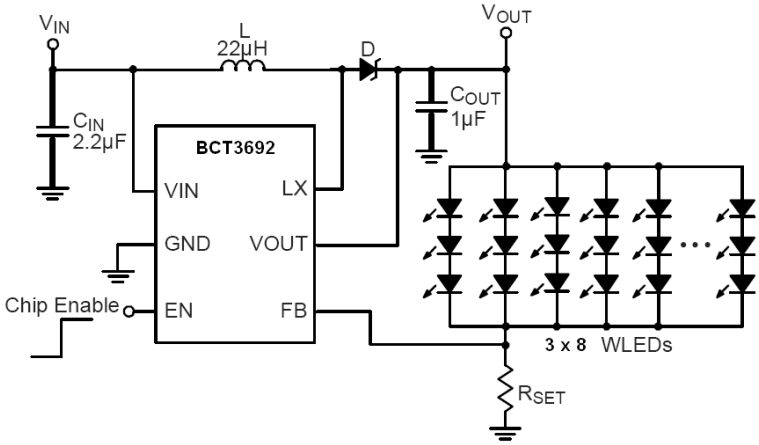


Figure 2. Application for Driving 3 X 13 WLEDs

Power Sequence

In order to assure the normal soft start function for suppressing the inrush current the input voltage should be ready before EN pulls high.

Soft-Start

The function of soft-start is made for suppressing the inrush current to an acceptable value at the beginning of power on. The BCT3692B provides a built-in soft-start function by clamping the output voltage of error amplifier so that the duty cycle of the PWM will be increased gradually in the soft-start period.

Current Limiting

The current flow through inductor as charging period is detected by a current sensing circuit. As the value comes across the current limiting threshold, the N-MOSFET will be turned off so that the inductor will be forced to leave charging stage and enter discharging stage. Therefore, the inductor current will not increase over the current limiting threshold.

Inductor Selection

The recommended value of inductor for 10 WLEDs applications is from 10μH to 47μH. Small size and better efficiency are the major concerns for portable devices, such as the BCT3692B used for mobile phone. The inductor should have low core loss at 1MHz and low DCR for better efficiency. The inductor saturation current rating should be considered to cover the inductor peak current.

Capacitor Selection

Input ceramic capacitor of 2.2μF and output ceramic capacitor of 1μF are recommended for the BCT3692B applications for driving 10 series WLEDs. For better voltage filtering, ceramic capacitors with low ESR are recommended. X5R and X7R types are suitable because of their wider voltage and temperature ranges.

Thermal Considerations

For continuous operation, do not exceed absolute maximum operation junction temperature. The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surroundings airflow and temperature difference between junction to ambient. The maximum power dissipation can be calculated by following formula :

$$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$$

Where $T_{J(MAX)}$ is the maximum operation junction temperature, T_A is the ambient temperature and the θ_{JA} is the junction to ambient thermal resistance. For the recommended operating conditions specification of BCT3692B, the maximum junction temperature of the die is 125°C. The junction to ambient thermal resistance θ_{JA} is layout dependent. The junction to ambient thermal resistance for TSOT-23-6 package is 255°C/W on the standard JEDEC 51-3 single layer thermal test board. The maximum power dissipation at

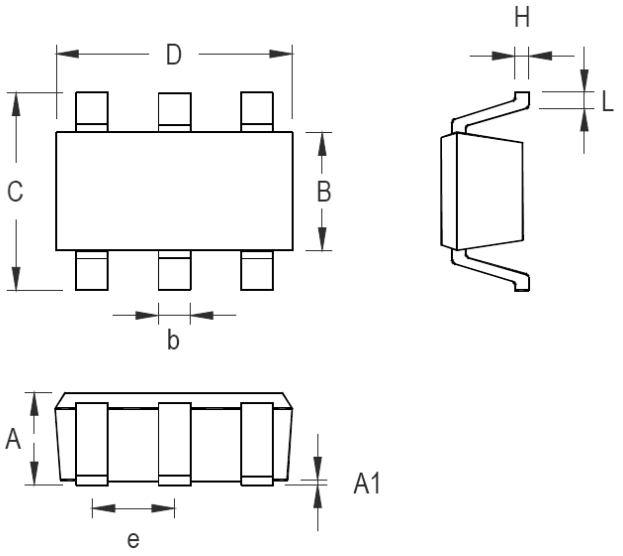
T_A = 25°C can be calculated by following formula :

$P_{D(MAX)}$ = (125°C – 25°C) / (255°C/W) = 0.392W for TSOT-23-6 packages.

Recommended Components for Typical Application Circuit

Reference	Qty	Part Number	Description	Manufacture
D	1	SR26	Schottky Diode	PANJIT
CIN	1	EMK107BJ225MA-T	Capacitor, Ceramic, 2.2uF/16V X5R	Taiyo Yuden
COUT	1	GMK107BJ105KA	Capacitor, Ceramic, 1uF/50V X5R	Taiyo Yuden
RSET	1	RC0603FR	Resistor, 1%	YAGEO
L	1	NR4018T220M	Inductor, 22uH	Taiyo Yuden

PACKAGING INFORMATION



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700	1.000	0.028	0.039
A1	0.000	0.100	0.000	0.004
B	1.397	1.803	0.055	0.071
b	0.300	0.559	0.012	0.022
C	2.591	3.000	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

TSOT-23-6 Surface Mount Package