Switch-Mode Boosted White LEDs Driver

Features

- V_{IN} Operating Range : 2.7V to 5.5V
- Maximum Output Voltage up to 15V
- Dimming with Frequency Range of 100 to 1kHz
- Soft-start function for inrush current control
- Over Voltage and Peak Switching-Current Detection
- Minimize the External Components
- Small LC Filter
- Build-in power MOS switch
- Internal Thermal Shut-Down
- TSOT-23-6 package, RoHS Compliant and 100% Green Product

Applications

- 7"LCD LED Backlight
- Mobile Phone LED Backlight
- MP3/PDA/DSC LED Backlight
- Battery Boost Voltage Converter
- Battery operated LED lighting

Description

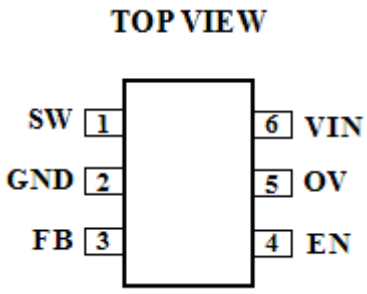
The AUR6110 is a high-efficiency and low-power LED driver for battery operated device applications. It is designed with a switch-mode step-up voltage conversion structure using an internal power MOS switcher. The driver provides a constant LED driving current with a feedback sensing circuit. The optimized power conversion is provided using an internal peak-current mode voltage-boost control loop design.

The chip includes Under Voltage Lock-Out (UVLO), Over-Voltage Detection (OVD) and Thermal-Shutdown (TSD) circuits to ensure reliable chip operations. A dynamic soft-start function is designed for reducing battery inrush-current during chip power-up.

The low-power CMOS circuit with minimized operating current can drive up to 4 series White LEDs in series (maximum number of LEDs dependent on LED forward voltages) from a signal cell Lithium Ion battery and driver 3S8P WLEDs light bar from input voltage of 5V for LCD display back-lighting.

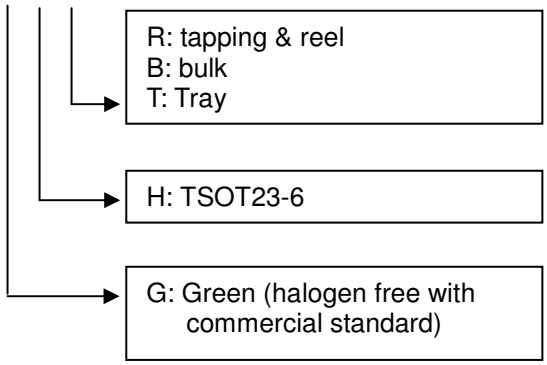
An optimized high-frequency built-in clocking enables applications of using a small LC filter for many battery powered products that requires only 5 external components. Tiny package of TSOT23-6L provides a best solution for space saving portable integration with a minimized total BOM cost.

Package Information



Order Information

AUR6110□□□



Application Circuit

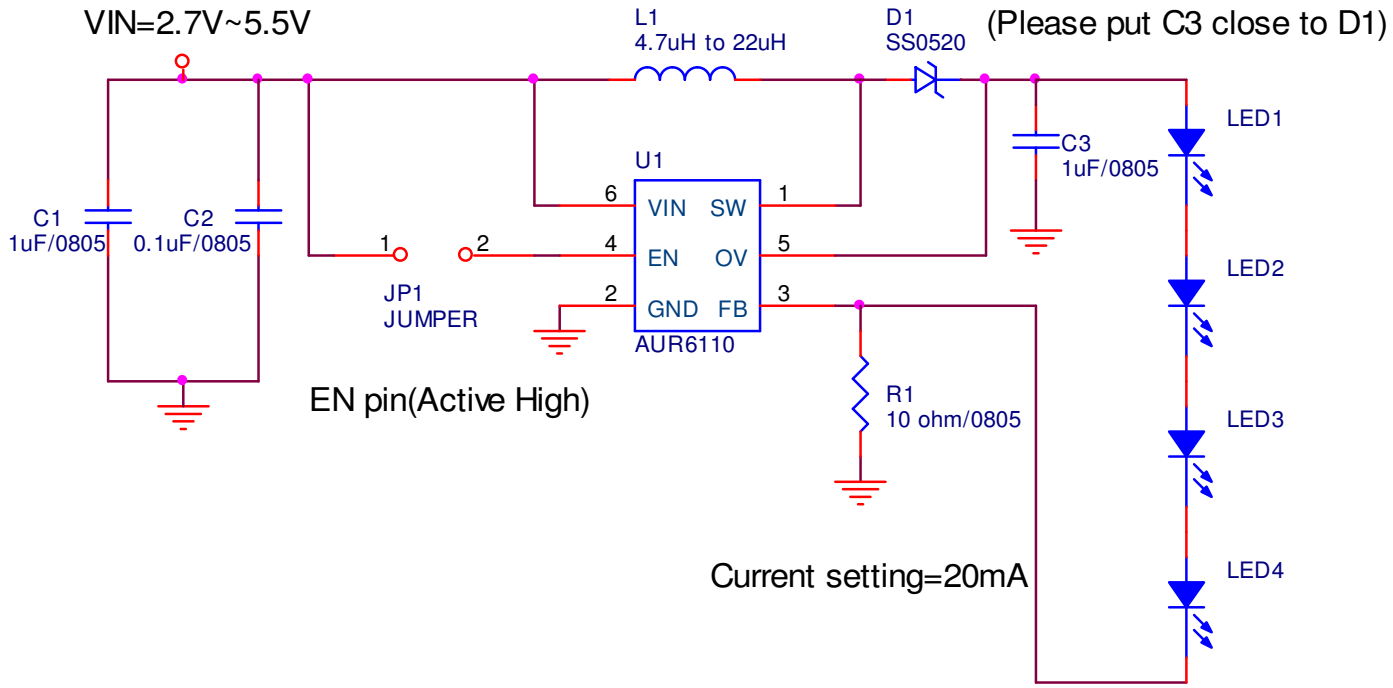


Figure1. Application for driving 4 series WLEDs

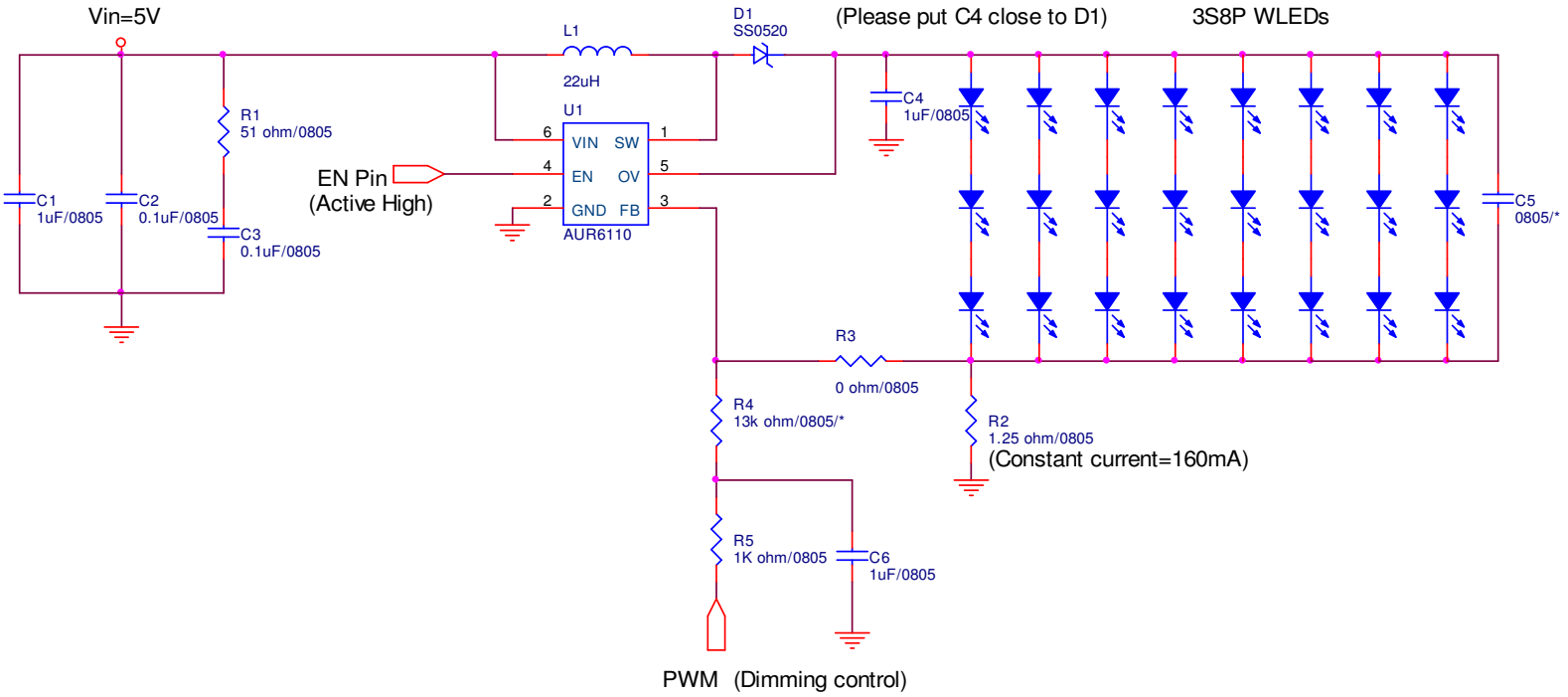
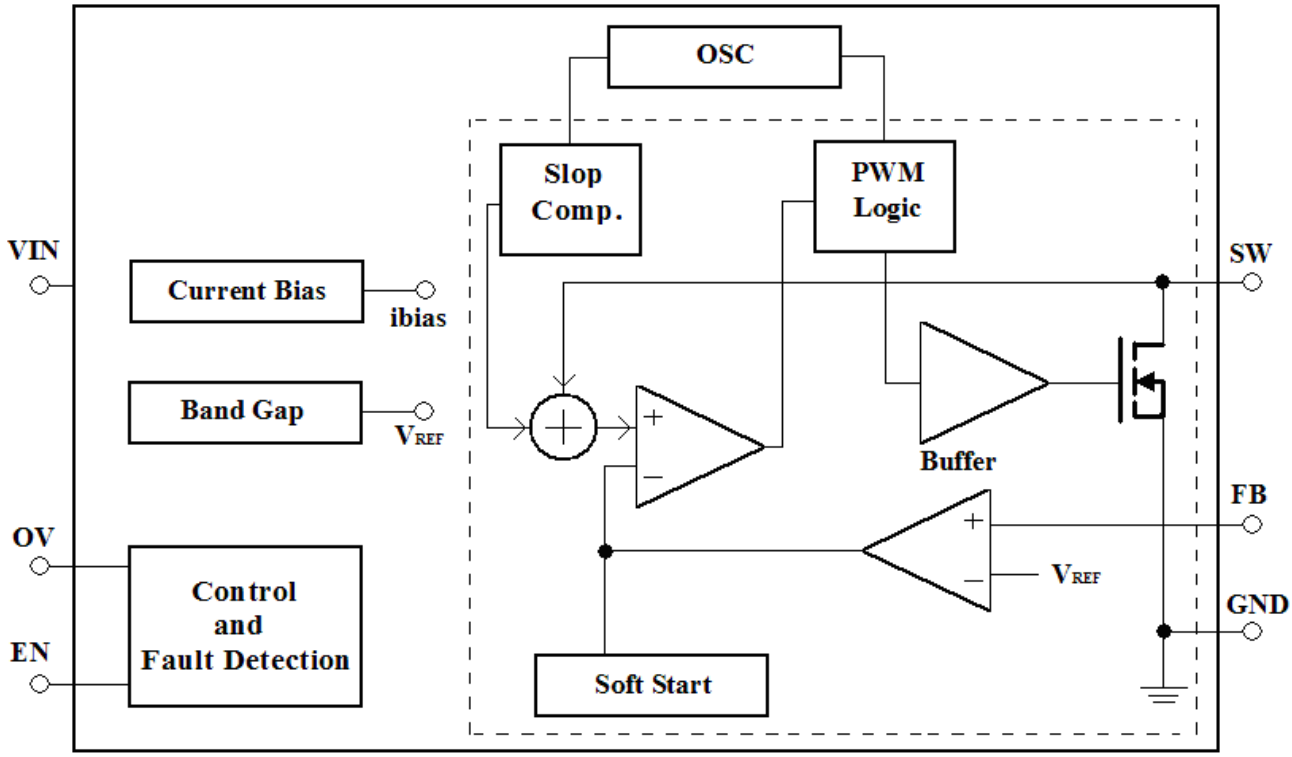


Figure2. Application for driving 3S8P WLEDs

Function Block Diagram



Pin Functions

TSOT-23-6	Pin Name	Pin Function
1	SW	Power Switch Output Pin. Connected to the drain of the internal Power MOS switcher also the external inductor and output rectifier diode. The wiring traces should be minimized for reducing EMI.
2	GND	Ground Pin.
3	FB	Feedback Sensing Pin at the connection of a current-sensing resistor and LED string.
4	EN	Chip Enable Input which is Active High. The pin is high impedance so it should not be left floating. A resistor of 100K could be connected for pull-down as needed.
5	OV	Over Voltage Detect Input Pin. It measures the output voltage for over voltage detection, to be connected to the top of the LED string with an optional output filtering capacitor.
6	VIN	Supply Input Voltage Pin, to be locally bypassed with capacitors to GND to reduce system noise.

Maximum Ratings

Characteristic	Symbol	Rating	Unit
Supply Input Voltage	VIN	–0.3V to 7	V
SW Input Voltage	VOUT	–0.3V to 17	V
OV Voltage		–0.3V to 17	V
The Other Pins		–0.3V to 7	V
Power Dissipation, P_D @ T_A = 25℃			
TSOT-23-6	P_D	0.450	W
Package Thermal Resistance			
TSOT-23-6, θ_{JA}	θ_{JA}	220	℃/W
Lead Temperature (Soldering, 10 sec.)		260	℃
Operation Temperature Range	T_{opr}	–40 to 80	℃
Junction Temperature Range	Tj,max	0 to 125	℃
Storage Temperature Range	T_{stg}	–65 to 150	℃
Operation Junction Temperature Range		0 to 125	℃

Recommended Operating Condition

Characteristic	Symbol	Rating	Unit
Supply Input Voltage	V_{IN}	2.7 to 5.5	V
Junction Temperature Range	Tj	–40 to 125	℃

Electrical Characteristics

(VIN = 3.7V, TA = 25℃ unless otherwise specified)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
System Supply Input						
Operation voltage Range	V_{DD}		2.7	-	5.5	V
Under Voltage Lock Out	V_{DD}		-	2.3	-	V
Quiescent Current	I_{DD}	FB=1.5V, No switch	-	330	-	uA
Supply Current	I_{DD}	FB=0V, Switch	-	2	-	mA
Shut Down Current	I_{DD}	EN < 0.4V	-	-	1	uA
Line Regulation		VIN : 3.0~4.3V	-	3	-	%
Oscillator & Dimming Frequency						
Operation Frequency	F_{OSC}		0.9	1.2	1.5	MHz
Maximum Duty Cycle			-	-	90	%
Dimming Frequency			100	-	1000	Hz
Reference Voltage						
Reference Voltage				0.2		V
MOSFET						
On Resistance of MOSFET	$R_{DS(ON)}$		-	0.75	-	Ω
OV Threshold	V_{OV}	For 2 to 4 WLEDs and 3S8P WLEDs light bar application.	-	15.1	-	V
Peak Current Limit			-	600	-	mA
Shut Down Voltage	V_{EN}		-	-	0.4	V
Enable Voltage	V_{EN}		1.5	-	-	V

Application Information:

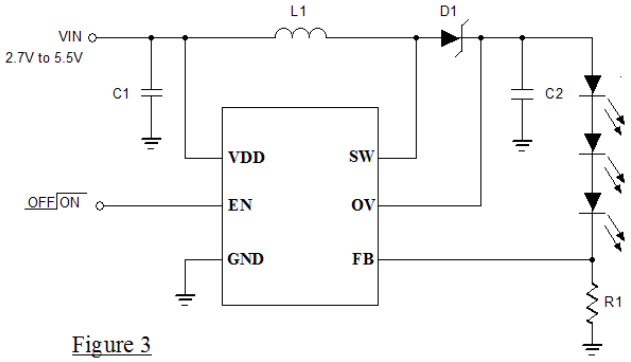


Figure 3

A typical application of AUR6110 is shown in Figure 3. The 3 WLEDs can be driven with a constant current of 20mA from a battery input voltage of 2.7V to 5.5 V. At 3S8P WLEDs light bar application in Figure 1. 3S8P WLEDs light bar can be driven with a constant current of 160mA from input voltage of 5V. A 1µF output capacitor is sufficient for most LED driving applications. A 22µH inductor with a low DCR (inductor resistance) is recommended to optimize the efficiency. Use of 1µF ceramic capacitor is recommended for the input filtering. A Schottky diode rated with 50mA to 500mA is suitable for AUR6110 applications. The chip has an internal soft-start function to limit the inrush current during power start-up mode.

Setting and Regulation of LED current

The AUR6110 regulates the LED current by connecting the current sense resistor (R1) between the feedback (FB) pin and ground. The LED driving current setting can be approximated by the following equation:

$$I_{LED}\,[mA] = \frac{V_{REF}}{R_{SET}\,[k\Omega]}$$

Example: LED Forward current = 20mA

R_{SET} = R1 = 0.2V / 20mA = 10 Ω

*The 1% tolerance recommended of R1 resistance.

Analog and Digital Dimming Applications

Alternately, a variable DC voltage can be used to control the feedback voltage as illustrated in Figure 4. The DC voltage changes the current of R1, R2 and R3 to establish the desired brightness with a new feedback voltage level to the internal control loop, with a DC voltage from 0V to 2V. When the PWM signal frequency is above 1KHz, dimming can be achieved by using the circuit as shown in Figure 5.

A digital PWM Dimming application can be seen in Figure 5. The dimming is achieved by applying an external PWM signal of 100 to 1KHz at EN pin. Varying of the PWM duty cycle from 0% to 100% controls the LED brightness.

Inductor Selection

The recommended value of inductor for 2 to 4 WLEDs application is 4.7 to 22µH and 3S8P WLEDs light bar application is 22uH for optimized integration and efficiency. The inductor should be low core loss at 1MHz and low DCR for required high efficiency. To avoid inductor saturation its current rating should be also carefully considered.

Capacitor Selection

Input and output ceramic capacitors of 1µF are recommended for AUR6110 application. For better voltage filtering, ceramic capacitors with low ESR are recommended. X5R and X7R types are suitable due to their wider voltage and temperature operating ranges.

Diode Selection

Schottky diode is a good choice for AUR6110 application because of its low forward voltage drop and fast reverse recovery switching to provide a needed efficiency and high-speed rectification operation. Current rating (RMS, root mean square value) of the diode must be according the equation as:

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

The diode's reverse breakdown voltage should be larger than the output voltage. SS0520 is recommended Schottky diode for rectifier.

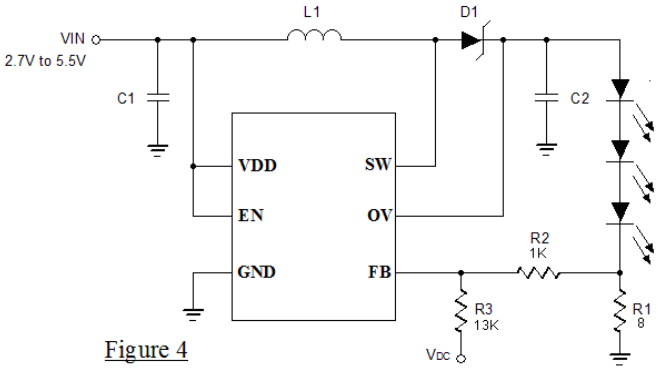


Figure 4

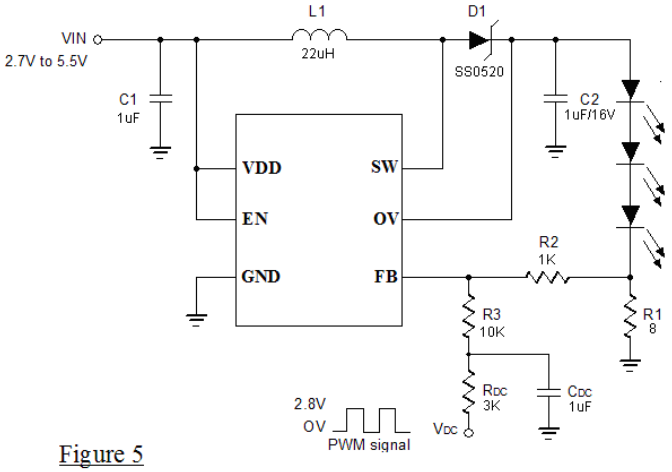
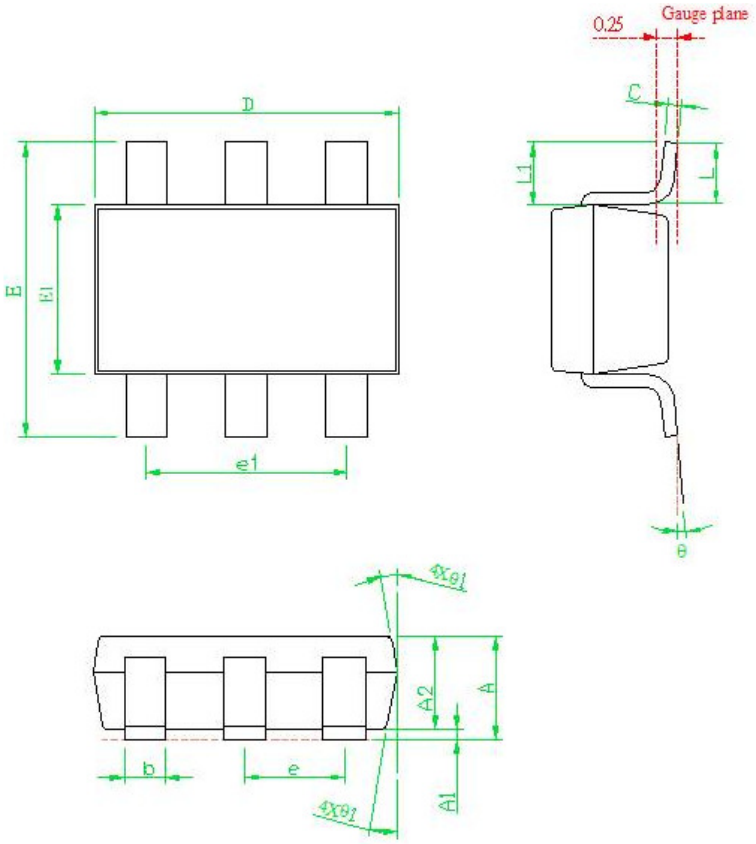


Figure 5

Package Information:

TSOT-23-6



SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	---	---	1.00
A1	0.00	0.05	0.10
A2	0.84	0.87	0.90
b	0.35	0.40	0.50
C	0.10	0.125	0.15
D	2.70	2.90	3.10
E1	1.40	1.60	1.80
e1	---	1.90(TYP)	---
E	2.60	2.80	3.00
L	0.30	0.40	0.60
θ	0°	4°	8°
θ1	4°	10°	12°
e	---	0.95(TYP)	---
L1	0.5	0.6	0.7

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