

40V LED Driver with 0.1% Dimming Accuracy

DESCRIPTION

The ETA1627 is a driver specially designed for back-lighting. It consists of a high accuracy current sink that allows low duty dimming and a high efficiency step-up converter with an integrated 40V power MOSFET. It runs with an optimal 0.8MHz frequency that enables use of small external components while still providing best efficiencies. It has an internal current limit as high as 1A, and it can drive up to 10 LEDs and 50mA in total output current. True PWM-Dimming can be achieved through the EN. One of the most important features of ETA1627 is that it provides an accurate current at dimming duty cycle down to 0.1%. This is very important for backlights that need to dim to very low light while still providing good consistency.

For maximum protection, the ETA1627 has an internal OVP protection at 38V to prevent the chip from damages when the LED string is not connected to the output.

ETA1627 is available in a space-saving SOT23-6 package.

FEATURES

- $\pm 10\%$ LED Current Accuracy at 1% Diming Ratio
- Capable of 0.1% dimming ratio
- Up to 85% Efficiency (6 LEDs)
- Drive up to 10 LEDs
- 38V Output Over Voltage Protection
- LED string Short Circuit Protection
- True PWM Brightness Control
- 1A current limit
- SOT23-6 Package

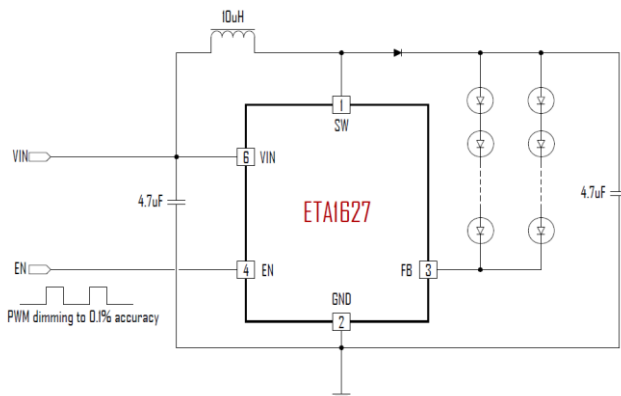
APPLICATIONS

- Cellphone and Smartphone
- MID or Tablet PC
- Camera
- Car DVR Recorder

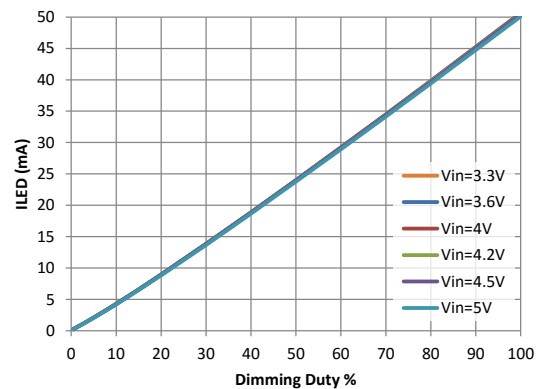
ORDERING INFORMATION

PART ID	PACKAGE	TOP MARK
ETA1627S2G	SOT23-6	JGYW (YW: Date Code)

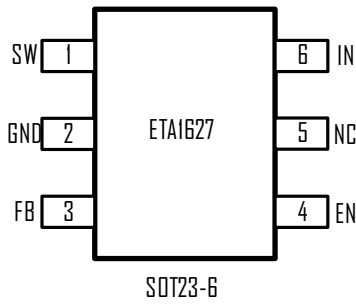
TYPICAL APPLICATION



ILED Vs. Dimming Duty



PIN CONFIGURATION



ABSOLUTE MAXIMUM RATINGS

(Note: Exceeding these limits may damage the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

SW, FB Voltage.....	-0.3V to 40V
All Other PIN voltages.....	-0.3V to 6.5V
SW to ground current	Internally limited
Operating Temperature Range	-40°C to 85°C
Storage Temperature Range	-55°C to 150°C
Thermal Resistance	θ_{JA} θ_{JC}
SOT23-6.....	100.....50.....°C/W

ELECTRICAL CHARACTERISTICS

(V_{IN} = 3.6V, unless otherwise specified. Typical values are at T_A = 25°C.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range		2.7		6	V
FB Current	100% duty	45	50	55	mA
	10% duty		5		mA
	1% duty	450	500	550	µA
Quiescent Current at IN	Switching at $I_{out}=0$		1.0	1.8	mA
	No Switching		0.3		mA
Shutdown Supply Current at IN	$V_{EN}=GND$		0	5	µA
Switching Frequency	$V_{IN}<4.3V$		0.8		MHz
Maximum Duty Cycle		90	93		%
NMOS Switch On Resistance	$I_{SW} = 100mA$		0.65		Ω
NMOS Switch Current Limit	$V_{IN} = 3.6V, 10 LEDs$		1		A
SW Leakage Current	$V_{SW}=0$ or 20V, $V_{EN}=GND$			10	µA
EN Input Low Voltage				0.6	V
EN Input High Voltage		1.2			V
PWM dimming frequency		25		100	KHz
Thermal Shutdown	Rising, Hysteresis=10°C		165		°C

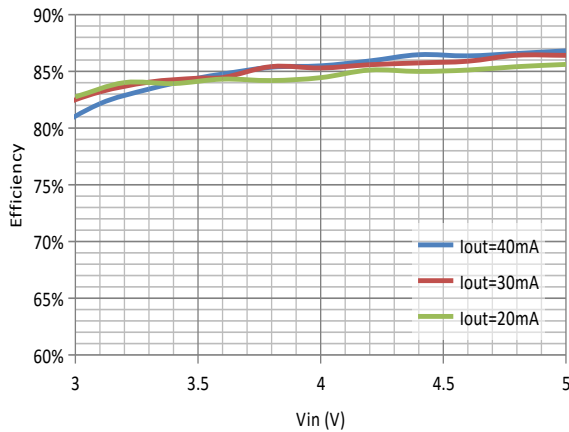
PIN DESCRIPTION

PIN #	NAME	DESCRIPTION
1	SW	Inductor Connection. Connect an inductor Between SW and IN.
2	GND	Ground Pin
3	FB	Feedback Input for Current. Connect this pin to the negative terminal of LED string.
4	EN	Control pin for the IC, It is default low. It is a multi-functional pin for enable control, PWM dimming
5	NC	Not connected, leave this PIN floating
6	IN	Input Supply pin. Bypass with a 4.7µF or larger ceramic capacitor to GND

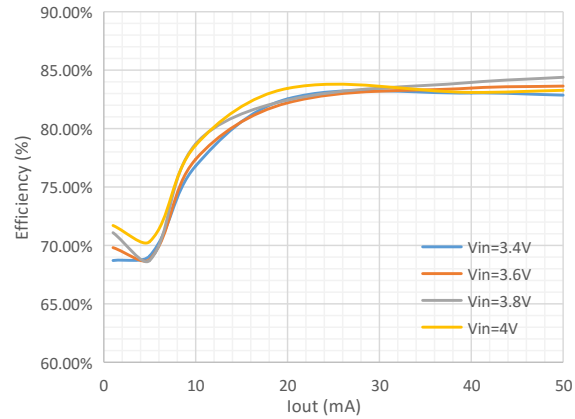
TYPICAL CHARACTERISTICS

(Typical values are at TA = 25°C unless otherwise specified.)

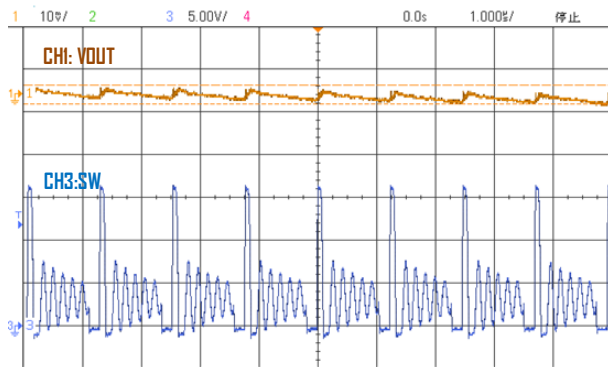
Efficiency of driving 6-LED-string



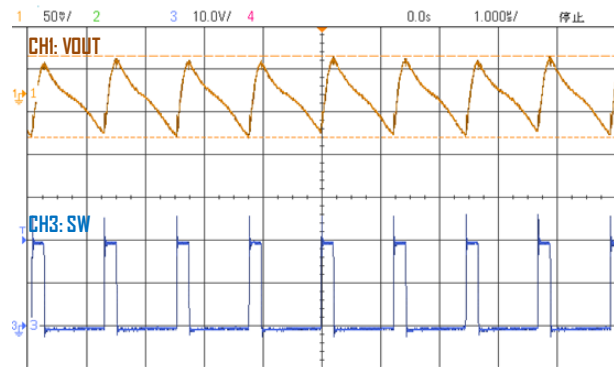
ETA1627 Efficiency Vs. Iout



Switching Waveform
VIN=3.6V, 6LEDs, Iout= 1mA



Switching Waveform
VIN=3.6V, 6LEDs, Iout= 40mA



FUNCTIONAL DESCRIPTIONS

The ETA1627 is a high efficiency boost LED driver with a small package size. The device is ideal for driving 4-20LEDs for backlight application in smartphone. The device integrates a 38V/1A switch FET and operates in pulse width modulation (PWM) with a 0.8MHz fixed switching frequency. The duty cycle of the converter is set by the error amplifier output and the current signal applied to the PWM control comparator.

Output Open Circuit Protection

Output open circuit protection circuitry prevents IC damage as the result of output open circuit (e.g. LED string absence). The ETA1627 monitors the voltage at the SW pin during each switching cycle. The circuitry turns off the switch FET and shuts down the IC when the SW voltage exceeds the VOVP threshold and persist for 8 switching clock cycles, which is 38V and as a result, the output voltage falls to the level of the input supply. The device remains in shutdown mode until it is enabled by toggling the EN

pin logic. The output voltage plus the FB pin voltage cannot exceed the minimum OVP threshold or $\text{OUTPUT VOLTAGE} + \text{VFB} \leq \text{VOVP(MIN)}$.

Shutdown

The ETA1627 enters shutdown mode when the EN voltage is logic low for more than 2ms. During shutdown, the input supply current for the device is less than 1 μ A (max). Although the internal FET does not switch in shutdown, there is still a DC current path between the input and the output through the inductor and Schottky diode.

For LED driving application, the minimum forward voltage of the LED array must exceed the maximum input voltage to ensure that the LEDs remain off in shutdown. However, in the typical application with two or more LEDs, the forward voltage is large enough to reverse bias the Schottky and keep leakage current low.

PWM Dimming Control or Output Voltage Programming

$$\text{IFB} = \text{Duty} * 50 \text{ mA}$$

Where

Duty = duty cycle of the PWM signal.

This PWM dimming eliminates the audible noise which often occurs when the output current is pulsed in replica of the frequency and duty cycle of PWM control. Unlike other scheme which filters the PWM signal for analog dimming, ETA1627 regulation voltage is independent of the PWM logic voltage level which often has large variations. For optimum performance, use the PWM dimming frequency in the range of 25kHz to 100kHz.

APPLICATION INFORMATION

Inductor Selection

Using an inductor with a smaller inductance value forces discontinuous PWM when the inductor current ramps down to zero before the end of each switching cycle. This reduces the boost converter's maximum output current, causes large input voltage ripple and reduces efficiency. Large inductance value provides much more output current and higher conversion efficiency. For these reasons, a 4.7 μ H to 10 μ H inductor value range is recommended. A 10 μ H inductor optimized the efficiency for most application while maintaining low inductor peak to peak ripple. Below table lists the recommended inductor for the ETA1627.

Recommended Inductors for ETA1627

L(μ H)	Saturation Current (mA)	Vendor
4.7- 10	>1500	Sunlord

Schottky Diode Selection

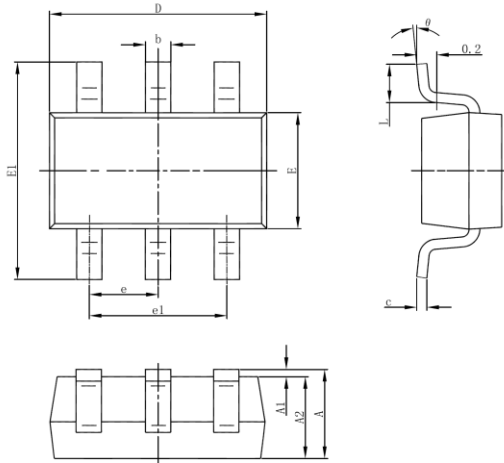
A high-speed rectifying Schottky with low parasitic capacitance is recommended for ETA1627 for maximum efficiency due to its high switching frequency. The diode average and peak current rating must be larger than the average output current and peak inductor current to ensure reliability. In addition, the diode's reverse breakdown voltage must exceed the open LED protection voltage.

Input and Output Capacitor Selection

The output capacitor is mainly selected to meet the requirements for the output ripple and loop stability. The output requires a capacitor in the range of 2.2 μ F to 10 μ F.

PACKAGE OUTLINE

SOT23-6



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°