ZETEX SEMICONDUCTORS

ZXSC380
Single or multi cell LED driver solution

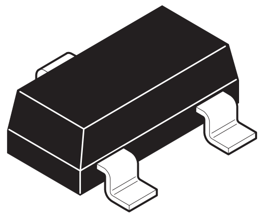
Description

The ZXSC380 is a highly integrated single or multi cell LED driver for applications where step-up voltage conversion from a very low input voltage is required. These applications mainly operate from 1.5V or 1.2V cells. The IC generates constant current pulses that are ideal for driving single or multiple LEDs over a wide range of operating voltages. The ZXSC380 provides a simple to use, low cost, space saving and easy to layout solutions.

The ZXSC380 uses a PFM control technique to drive an internal switching transistor which has a low saturation resistance. This ensures high efficiency, even for input voltages as low as 1V.

The IC can start up under full load and operates down to an input voltage of only 0.9V typical.

The ZXSC380 is offered in the space saving SOT23 package or in die form, offering an excellent cost vs performance solution for single cell LED driving applications.



SOT23

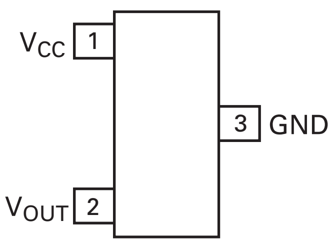
Features

- 80% efficiency
- User adjustable output current
- Single cell operation
- Low saturation voltage switching transistor
- Simple application circuit
- Low external component count
- SOT23 package
- Available also in die form

Applications

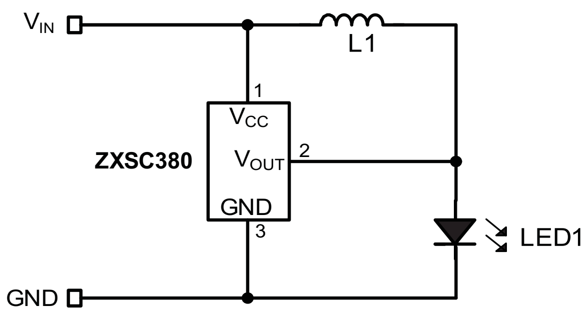
- LED flashlights and torches
- LED backlights
- White LED driver

Pin connections



Top view

Typical application circuit



Absolute maximum ratings

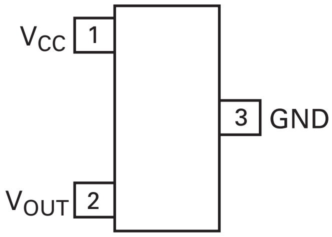
Supply voltage (V_{CC})	-0.6V to 10V
Output voltage (V_{OUT})	-0.6V to 20V
Supply current	20mA
Output switch current	200mA
Power dissipation SOT23-3	450mW
Power dissipation die	1W
Operating temperature range	0°C to +85°C
Storage temperature range	-55°C to +150°C

Electrical characteristics

Measured at T_{amb} = 25°C, L = 100μH and V_{CC} = 1.5V unless otherwise specified.

Parameter	Conditions	Limits			Units
		Min.	Typ.	Max.	
Supply voltage operating range		0.8		6	V
Minimum supply start-up voltage			0.9	1.0	V
Switch current	V_{OUT} = 1.0V	65	80	95	mA
Switch saturation voltage	IV_{OUT} = 50mA		0.3	0.5	V
Mean LED current	V_{LED} = 3.5V		18		mA
Efficiency	V_{LED} = 3.5V		75		%
Operating frequency	V_{LED} = 3.5V		160		kHz
Discharge pulse width		1.4	2.2	3.0	μs

Pin descriptions



Top view

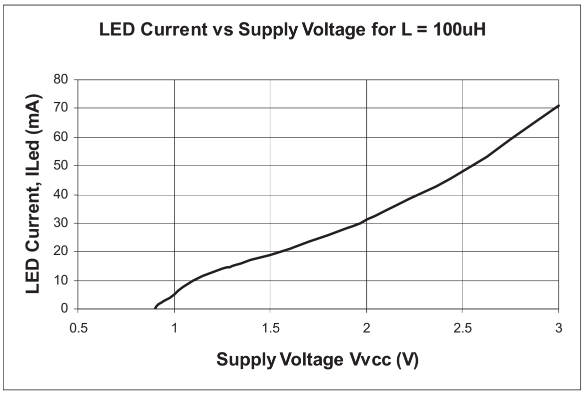
Pin descriptions

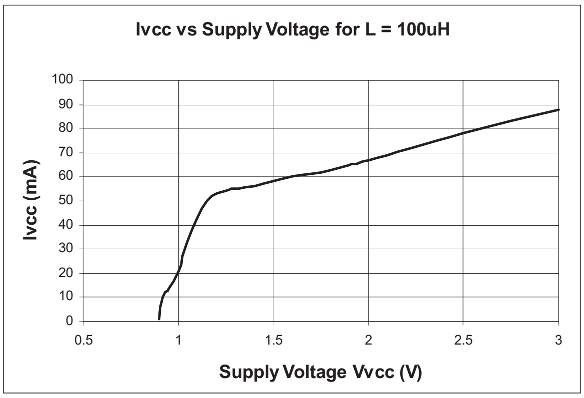
Pin No.	Name	Description
1	V_{CC}	Supply voltage, generally Alkaline, NiMH or NiCd single cell
2	V_{OUT}	Switch output external inductor/LED
3	GND	Ground

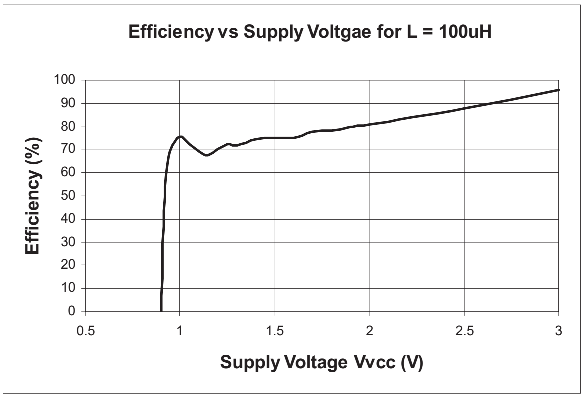
Ordering information

Device	Package	Part Mark
ZXSC380FH	SOT23	380

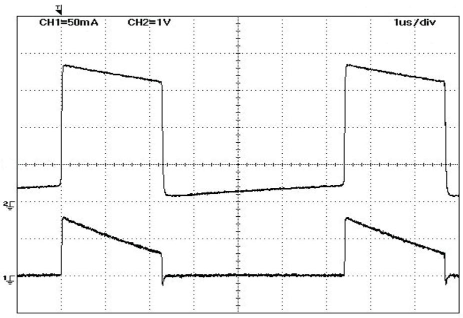
Typical characteristics





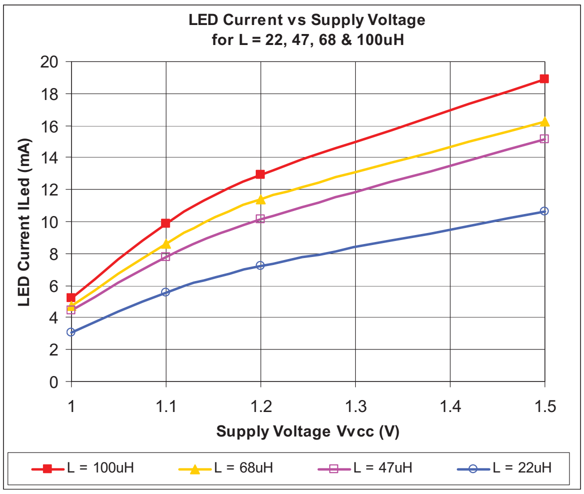


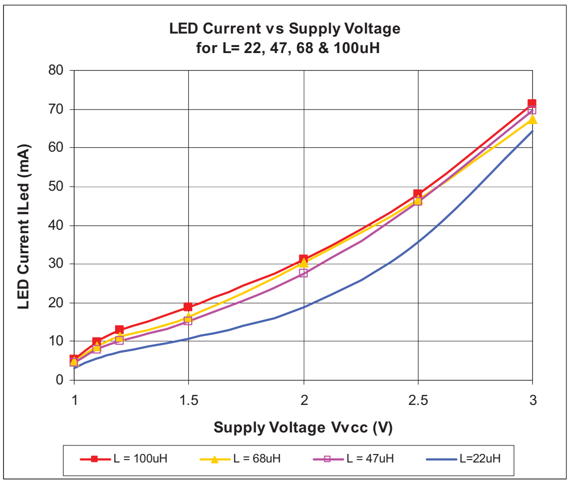
Operating Waveforms

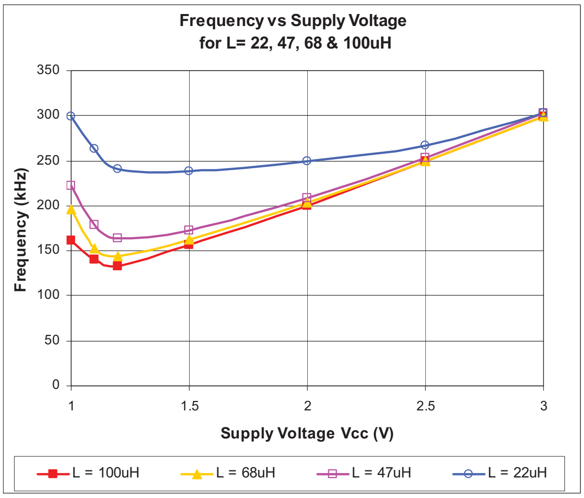


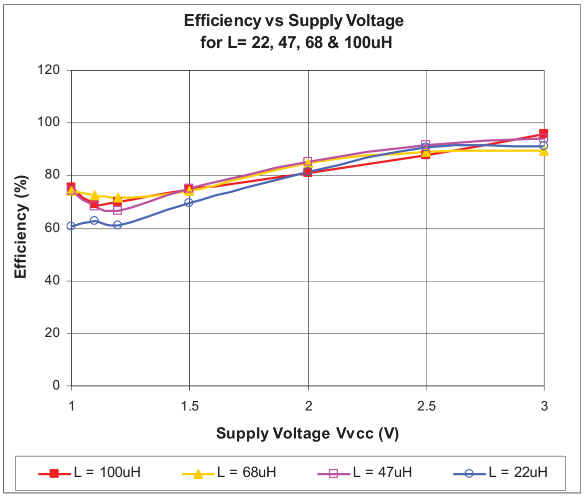
Channel 1 (lower): LED current ILed. 50mA/div.
Channel 2 (upper): Voltage at Vout pin. 1V/div

Typical characteristics









Device description

The ZXSC380 is non-synchronous PFM, DC-DC controller IC which, with a high performance internal transistor, for a high efficiency boost converter for use in single cell applications. A block diagram is shown in Figure 1.

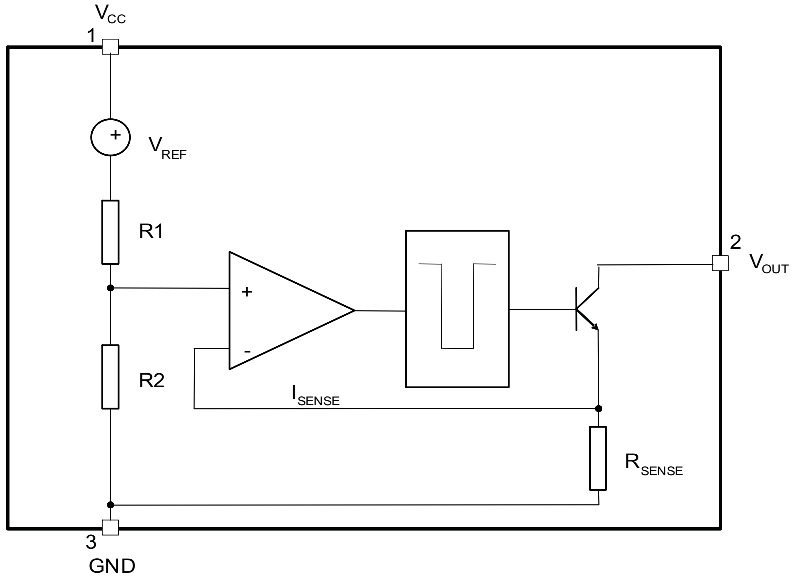


Figure 1 ZXSC380 Block diagram

The on chip comparator forces the driver circuit and therefore the internal switching transistor to switch off when the voltage at I_{SENSE} exceeds 20mV. This threshold is set by an internal reference circuit and divider. The voltage at I_{SENSE} is taken from a current sense resistor connected in series with the emitter of the switching transistor. This resistor is chosen to give 20mV at I_{SENSE} for an emitter current of 80mA.

A monostable following the output of the comparator forces the turn-off time of the output stage to be typically 2.2µs. This ensures that there is sufficient time to discharge a significant proportion of the energy stored in the inductor coil before the next On period.

With every On pulse the switching transistor is kept on until the voltage across the current-sense resistor exceeds the threshold of the I_{SENSE} input. The On-pulse length, and therefore the switching frequency, is determined by the programmed peak current, the input voltage and the input to output voltage differential. See applications section for details.

The Driver circuit supplies the internal switching transistor with a fixed drive current. To maximize efficiency the internal transistor is switched quickly, typically being switched off within 30ns.

Application notes

Typical application circuit

Figure 2 shows a typical boost circuit for 18mA LED current from a single cell 1.5V supply. The inductor value is 100μH. The operating frequency is typically 160kHz typical for 1.5V supply.

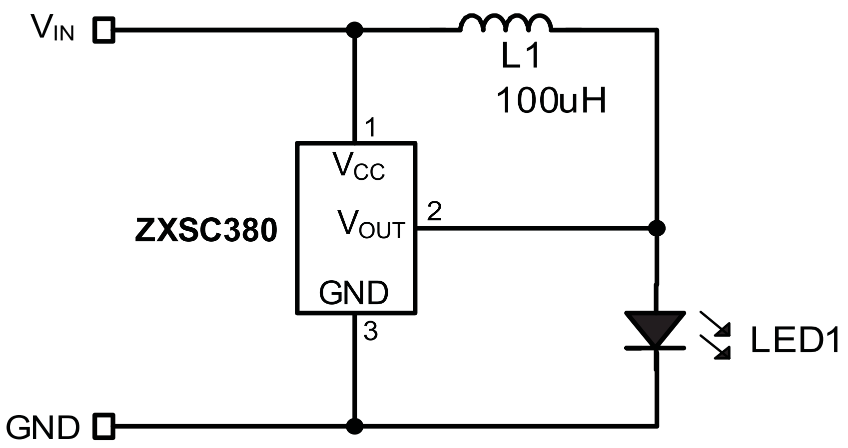


Figure 2 Typical application circuit

The LED current can be set by the choice of inductor values described below.

Inductor selection and current setting

Figure 3 shows the LED current vs the supply voltage while Figure 4 shows the switching frequency vs the supply voltage for various inductor values. Figure 3 and 4 can be used as guides to the inductor value selection. The inductor should have a low DC resistance for high efficiency. The switching frequency is dependent on the programmed peak current, the input voltage, the input to output voltage differential and the inductor value.

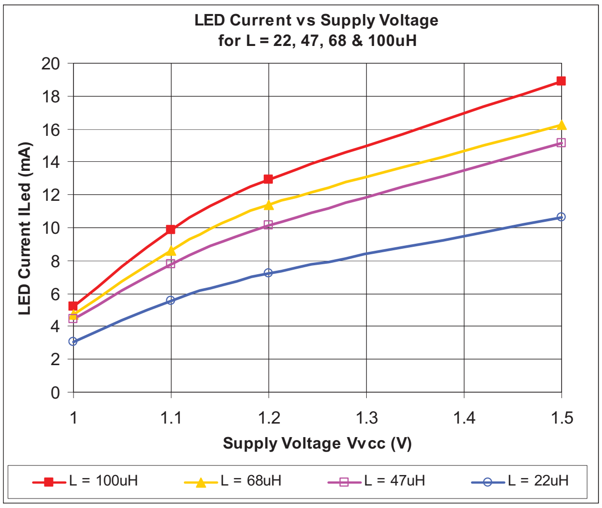


Figure 3 The LED current vs the supply voltage for various inductor values

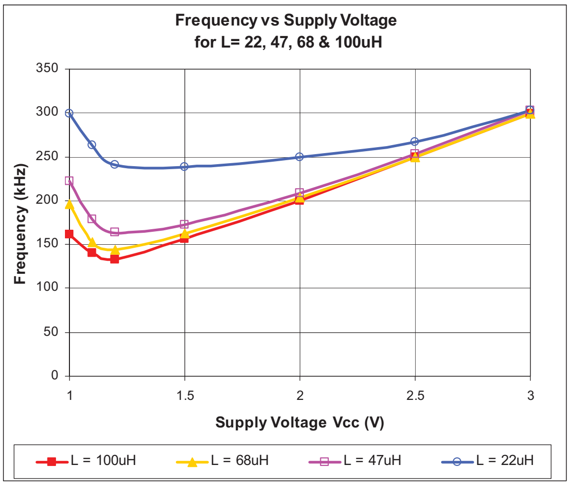


Figure 4 Switching frequency vs the supply voltage for various inductor values

Bootstrap operation

The ZXSC380 can be operated in bootstrap mode, as shown in Figure 5, to operate down to 0.7V typical after the initial successful start up. The operation down to 0.7V typical allows further cell energy to be extracted beyond typically quoted end of battery voltage of approx. 0.9. This prolongs the battery use time. (Note: Some batteries may have low voltage protections and may switch the supply off.) The schotkky diodes, D1 and D2, should have a very low forward voltage, e.g. of such part is Zetex ZHCS400 (SOD323 package) or Zetex BAT54C (dual schotkky diode with common Cathode). The start up voltage is 0.9V typical without bootstrap, however, due to the additional schotkky, D1, being in the path of the supply to the Vcc pin, the start up voltage can be 1.1V typical for the bootstrap configuration.

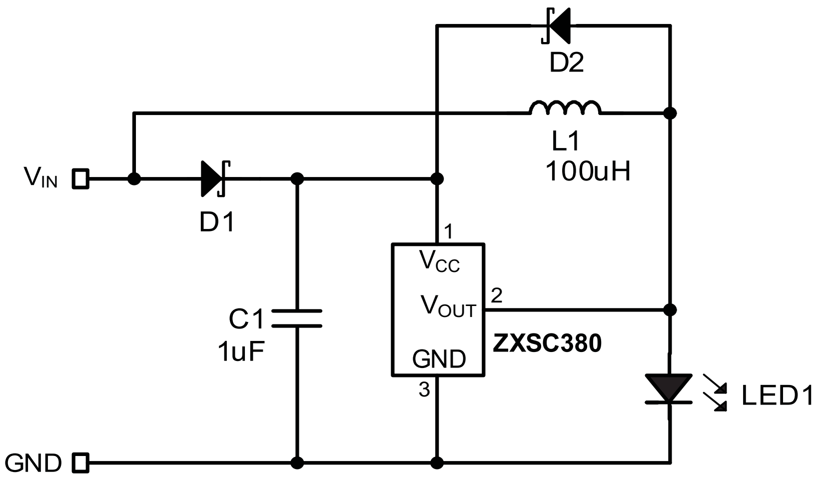


Figure 5 ZXSC380 in bootstrap mode

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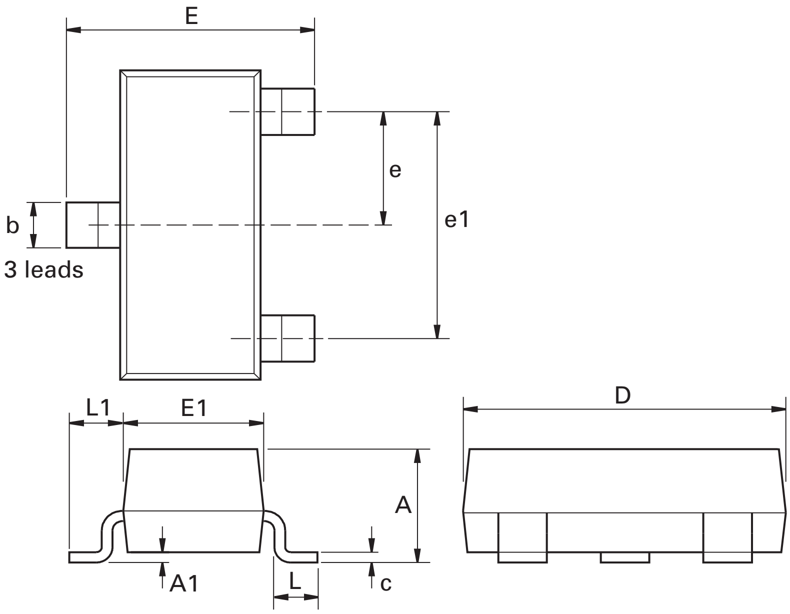
Package outline - SOT23



Dim.	Millimeters		Inches		Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	-	1.12	-	0.044	e1	1.90 NOM		0.075 NOM	
A1	0.01	0.10	0.0004	0.004	E	2.10	2.64	0.083	0.104
b	0.30	0.50	0.012	0.020	E1	1.20	1.40	0.047	0.055
c	0.085	0.20	0.003	0.008	L	0.25	0.60	0.0098	0.0236
D	2.80	3.04	0.110	0.120	L1	0.45	0.62	0.018	0.024
e	0.95 NOM		0.037 NOM		-	-	-	-	-

Note: Controlling dimensions are in millimeters. Approximate dimensions are provided in inches

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