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# ZXLD381

## Single or Multi Cell LED Driver Solution

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### Summary

The ZXLD381 is a single cell LED driver designed 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 ZXLD381 uses a PFM control technique to drive an internal switching transistor which exhibits

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.

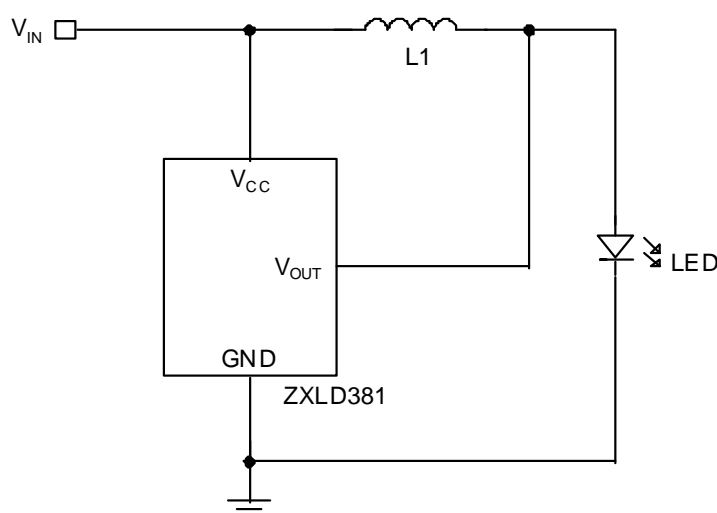
The ZXLD381 is offered in the space saving SOT23 package or in die form, offering an excellent cost vs performance solution for single cell LED driving applications.

### Features

- 85% Efficiency
- User adjustable output current
- Single cell operation (0.9V minimum)
- Low saturation voltage switching transistor
- SOT23-3 package
- Available also in Die form
- Simple Application circuit

### Applications

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



## Absolute maximum ratings

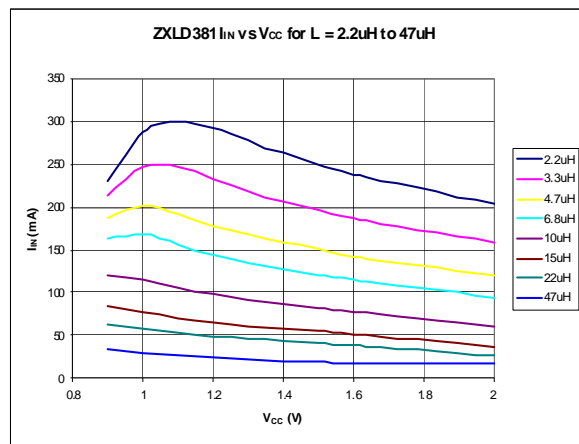
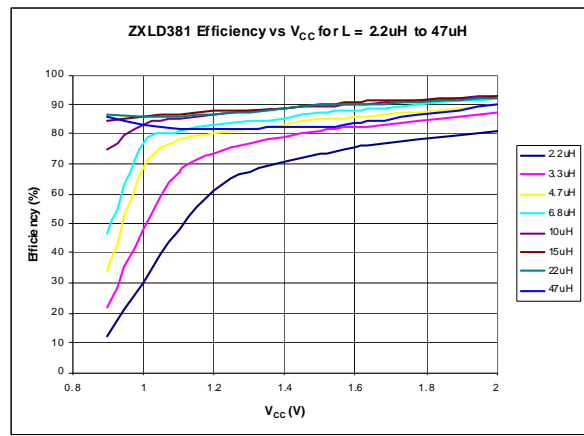
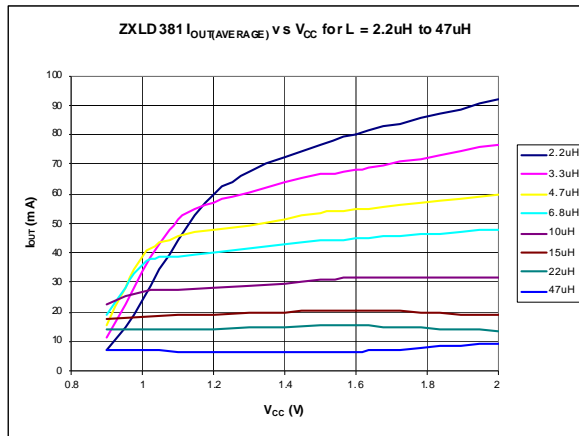
Supply Voltage ( $V_{CC}$ )	-0.6V to 10V
Output Voltage ( $V_{OUT}$ )	-0.6V to 20V
Supply Current	20mA
Output Switch Current	800mA
Power Dissipation SOT23-3	450mW
Power Dissipation Die	1W
Operating Temperature Range	0°C to +85°C
Storage Temperature Range	-55°C to +150°C

## Electrical Characteristics

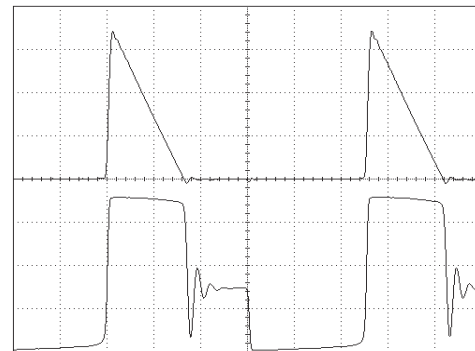
Measured at  $T_{AMB} = 25^{\circ}\text{C}$ ,  $L = 4.7\mu\text{H}$  and  $V_{CC} = 1.5\text{V}$  unless otherwise specified.

Parameter	Conditions	Limits			Units
		Min	Typ	Max	
Supply Voltage Operating Range	$L = 10\mu\text{H}$	0.9		2.2	V
Minimum Supply Start-up Voltage	$L = 10\mu\text{H}$		0.8	0.9	V
Switch Current	At turn-off	250	320	400	mA
Switch Saturation Voltage	$I_{OUT} = 200\text{mA}$		100	300	mV
Switch Leakage Current	$V_{OUT} = 20\text{V}$	40	70	120	$\mu\text{A}$
Mean LED Current	$V_{LED} = 3.5\text{V}$	40	55	70	mA
Efficiency	$V_{LED} = 3.5\text{V}$		85		%
Operating Frequency	$V_{LED} = 3.5\text{V}$		350		kHz
Discharge Pulse Width		0.7	1.5	2.5	$\mu\text{s}$

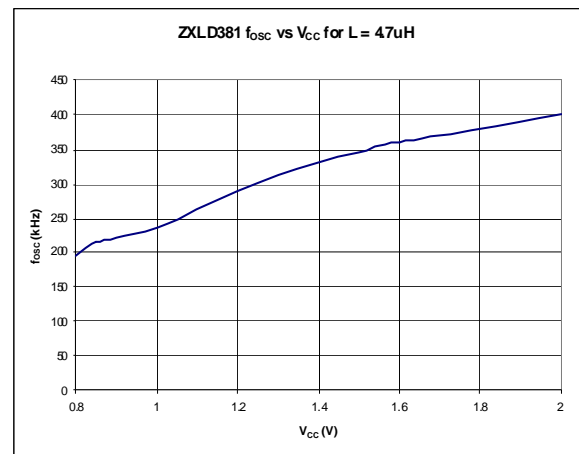
## Typical Characteristics



**ZXLD381 Operating Waveforms for  $L = 4.7\mu H$ ,  $V_{CC} = 1.5V$**

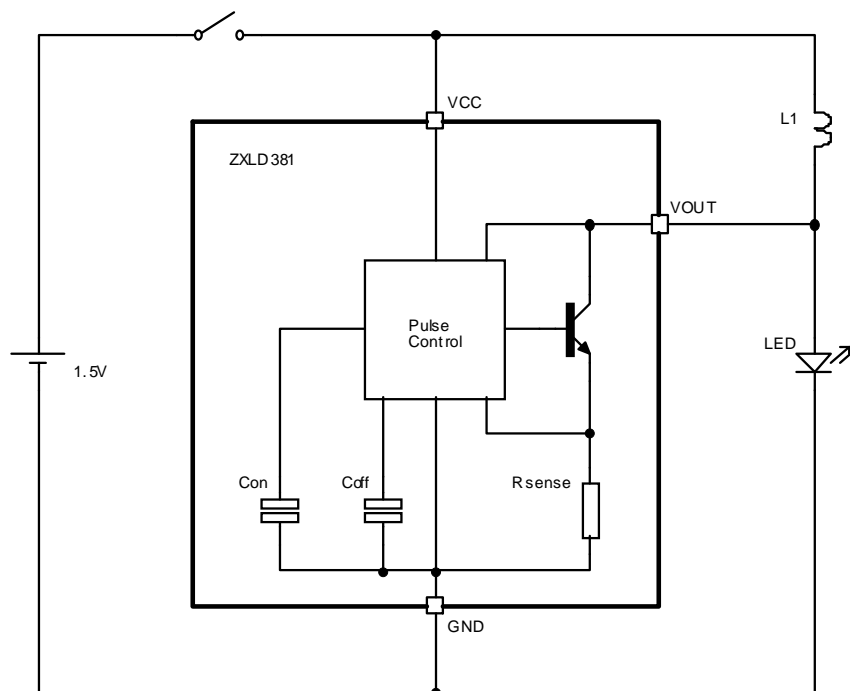


Channel-1 (Upper):  $I_{LED}$  @ 100mA/cm  
 Channel-2 (Lower):  $V_{OUT}$  @ 1V/cm  
 Timebase: 500ns/cm



## Device Description

The ZXLD381 is a simple PFM, DC-DC controller combined with a high performance internal switching transistor, enabling the production of a high efficiency boost converter for use in single cell applications. A block diagram is shown for the ZXLD381 in Fig 1.



**Figure 1 ZXLD381 Block Diagram**

When power is applied, an oscillator within the pulse control block forces the internal switching transistor to switch on to start an energy charge cycle. The low saturation voltage switch pulls the  $V_{OUT}$  pin close to ground which forces the supply voltage across the external inductor  $L1$ . This causes a current to build up, storing energy in the inductor. During this phase, switch current and supply voltage are monitored and used by the pulse control circuit to determine the optimum drive conditions and on-time. At the end of the energy charge cycle, the internal switch is turned off rapidly, interrupting the current flow through  $L1$  which causes the voltage on  $V_{OUT}$  to rise dramatically. When the voltage on  $V_{OUT}$  reaches the load LED's forward (on) voltage, the inductor current is transferred from the internal switch to the LED, starting the energy discharge cycle. With the voltage across the inductor reversed, the current flowing through it (and the LED) now falls. When the inductor current reaches zero, the voltage on the  $V_{OUT}$  pin falls back towards  $V_{CC}$ . This action is sensed by the pulse control circuit, which initiates the next energy charge cycle. Except for low level losses, all the energy stored in the inductor during a charge cycle will be channelled to the load LED during the following discharge cycle.

The current fed into the load LED has a sawtooth waveform, the average (DC) value of which is kept constant by the pulse control circuit for varying supply voltage and temperature. It is possible to change the output current given by the ZXLD381 by changing the value of inductor  $L1$ . The larger the inductance of  $L1$ , the lower the output current. A table/graph showing the relationship between inductance and output current is given later in this datasheet. Since the

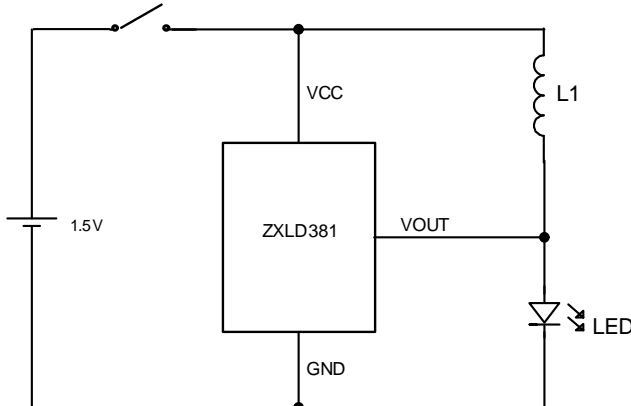
# ZXLD381

output current of the ZXLD381 is a sawtooth waveform, its peak value is substantially larger than the DC/average value. The table also provides this data.

The internal switching transistor has a minimum collector-emitter breakdown voltage of 20V and this sets the maximum load voltage allowable. The minimum value is set by a feature of the pulse control circuit that requires the load voltage to be at least 0.8V greater than  $V_{CC}$ . (The device will function with load voltages smaller than this but output current regulation will be impaired.) Higher than nominal load voltages will lower the average (DC) output current generated for a given inductor value.

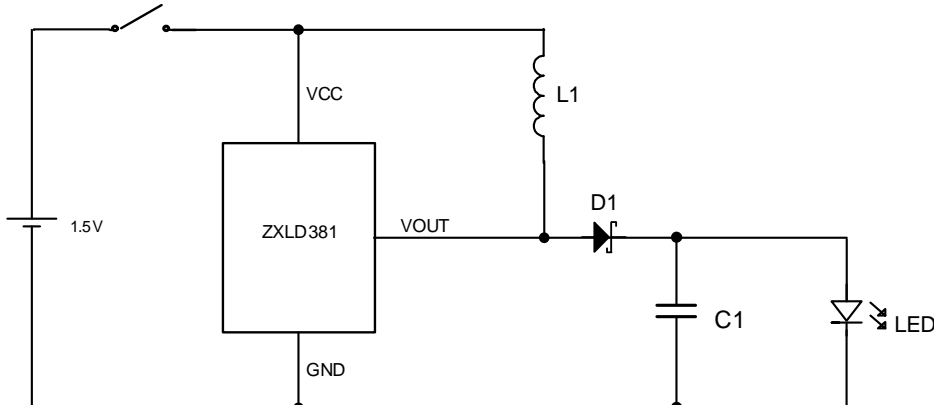
## Application Examples

### Standard Operating Mode

	L	$I_{LED(peak)}$	$I_{LED(avg)}$
	( $\mu H$ )	(mA)	(mA)
	47	35	6.5
	22	80	15
	15	120	20
	10	190	30
	6.8	260	45
	4.7	380	55
	3.3	510	67
	2.2	640	76

Note:  $V_{LED} = 3.5V$

### Low Ripple LED Current Mode

	L	$I_{LED}$
	( $\mu H$ )	(mA)
	47	6
	22	13.5
	15	18
	10	27
	6.8	41
	4.7	50
	3.3	61
	2.2	69

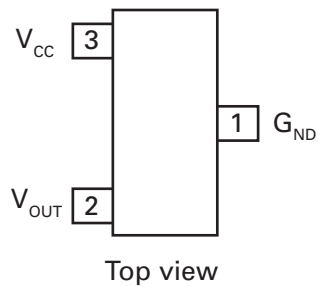
Note:  $V_{LED} = 3.5V$ , D1 = ZHCS1000, C1 =  $1\mu F$  (low ESR)

# ZXLD381

## PIN Descriptions

Pin No.	Name	Description
1	G <sub>ND</sub>	Ground
2	V <sub>OUT</sub>	Switch output external inductor/LED
3	V <sub>CC</sub>	Supply voltage, generally Alkaline, NiMH or NiCd single cell

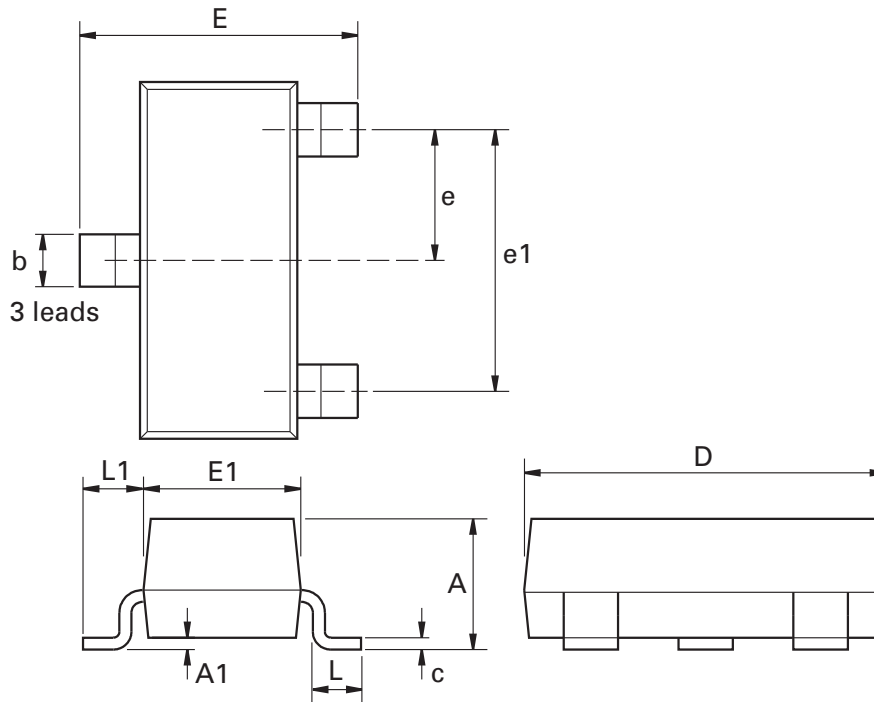
## Pinout diagram



## Ordering Information

Device	Package	Part Mark
ZXLD381FHTA	SOT23	381

## Packaging Information- 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 millimetres. Approximate dimensions are given in inches.

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