ZXLD381
Single or Multi Cell LED Driver Solution

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.

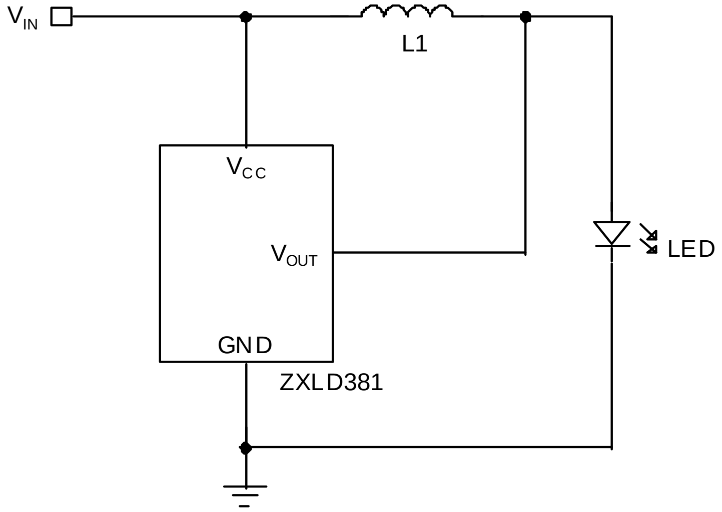
The ZXLD381 is offered in the space saving SOT23 package or in die form, offering an excellent cost vs performance solution for single cell LED driving applications.

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



© Zetex Semiconductors plc 2008

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

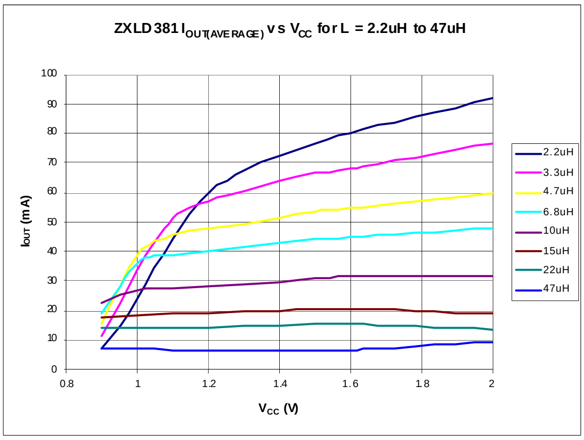
Electrical Characteristics

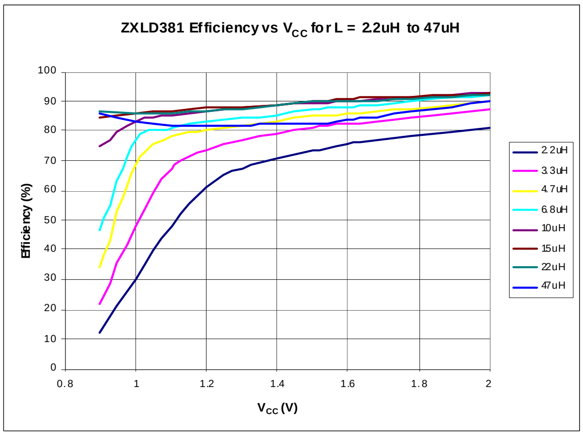
Measured at T_{AMB} = 25°C, L = 4.7µH and VCC = 1.5V unless otherwise specified.

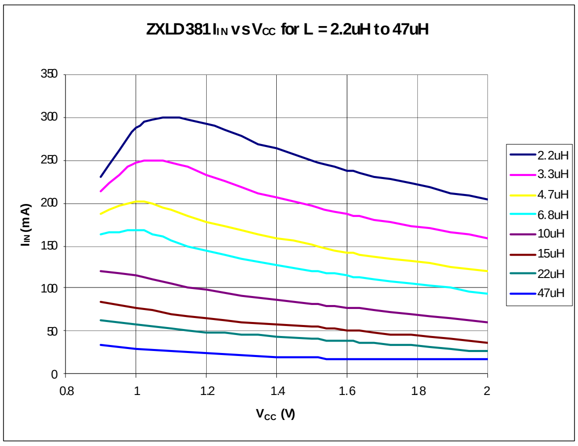
Parameter	Conditions	Limits			Units
		Min	Typ	Max	
Supply Voltage Operating Range	L = 10µH	0.9		2.2	V
Minimum Supply Start-up Voltage	L = 10µH		0.8	0.9	V
Switch Current	At turn-off	250	320	400	mA
Switch Saturation Voltage	I_{OUT} = 200mA		100	300	mV
Switch Leakage Current	V_{OUT} = 20V	40	70	120	µA
Mean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

© Zetex Semiconductors plc 2008

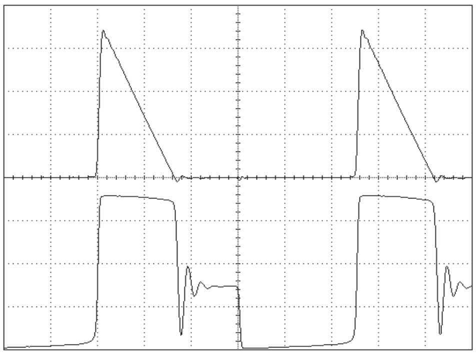
Typical Characteristics



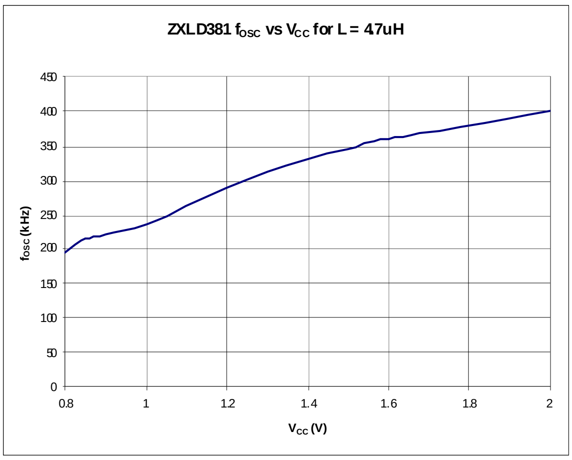




ZXLD381 Operating Waveforms for L = 4.7uH, VCC = 1.5V



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



© Zetex Semiconductors plc 2008

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.

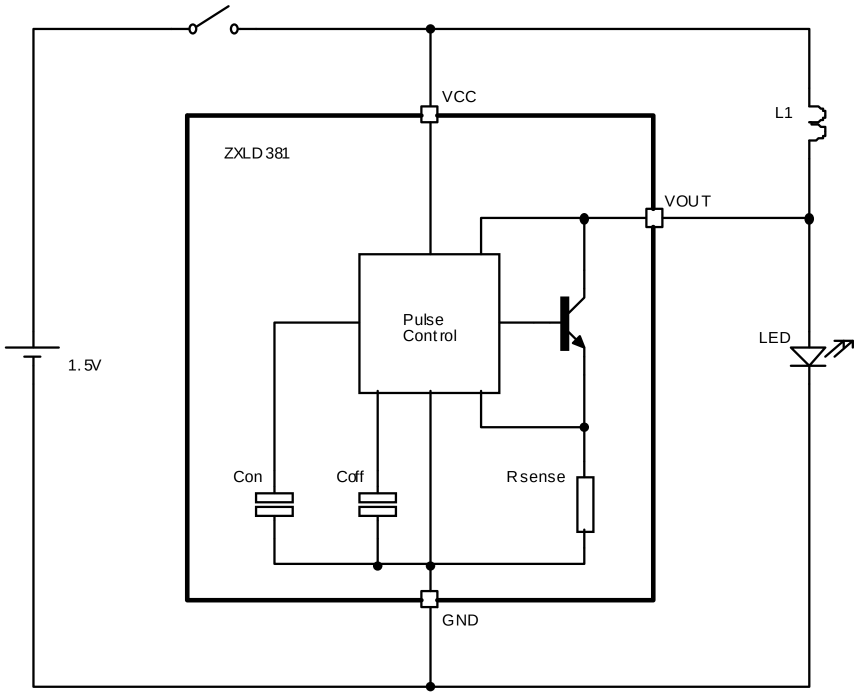


Figure 1 ZXLD381 Block Diagram

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

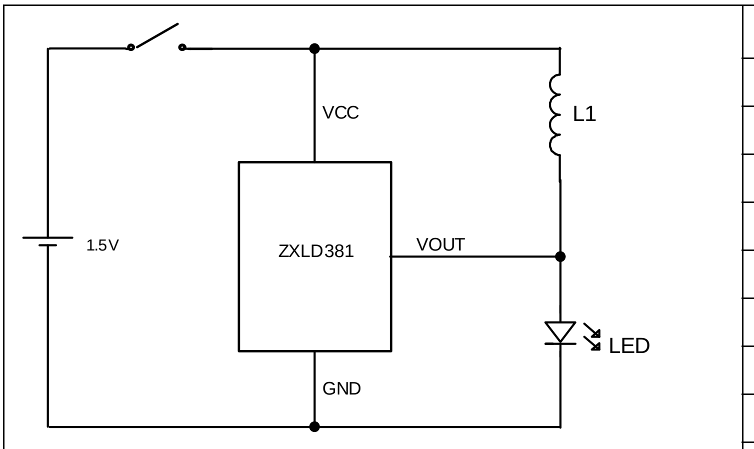
© Zetex Semiconductors plc 2008

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

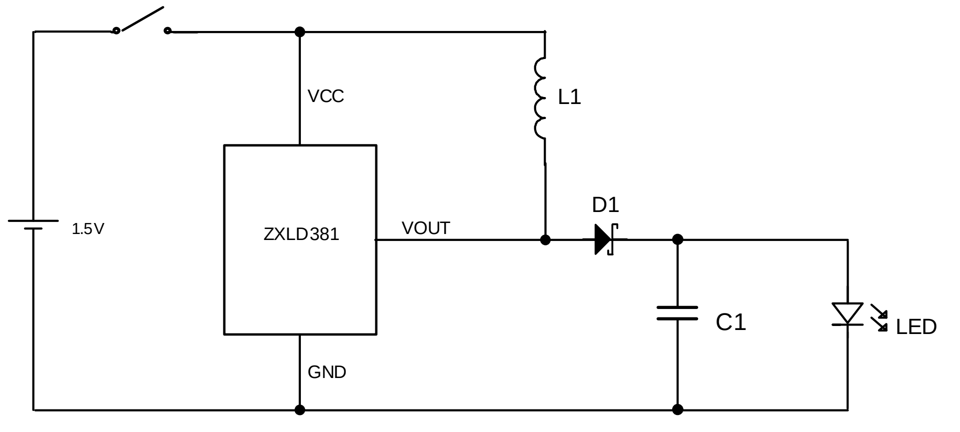
Standard Operating Mode



L	I_{LED}(peak)	I_{LED}(avg)
(uH)	(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}
(uH)	(mA)
47	6
22	13.5
15	18
10	27
6.8	41
4.7	50
3.3	61
2.2	69

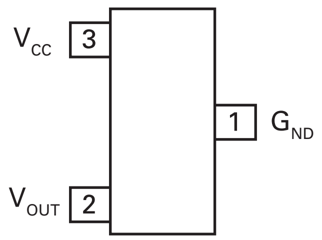
Note: V_{LED} = 3.5V, D1 = ZHCS1000, C1 = 1µF (low ESR)

© Zetex Semiconductors plc 2008

PIN Descriptions

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

Pinout diagram



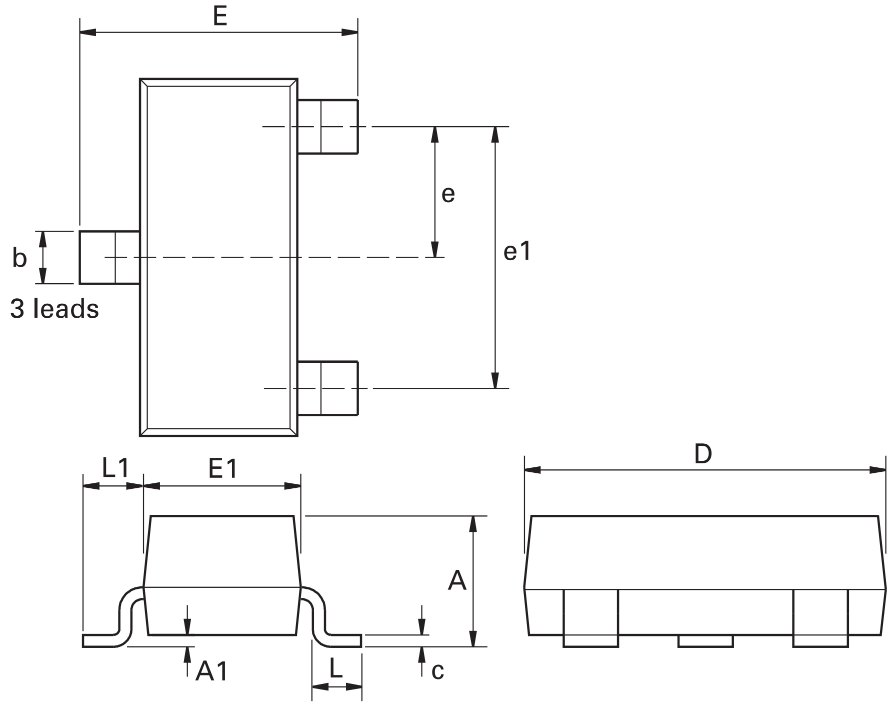
Top view

Ordering Information

Device	Package	Part Mark
ZXLD381FHTA	SOT23	381

© Zetex Semiconductors plc 2008

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.

© Zetex Semiconductors plc 2008

Definitions

Product change

Zetex Semiconductors reserves the right to alter, without notice, specifications, design, price or conditions of supply of any product or service. Customers are solely responsible for obtaining the latest relevant information before placing orders.

Applications disclaimer

The circuits in this design/application note are offered as design ideas. It is the responsibility of the user to ensure that the circuit is fit for the user's application and meets with the user's requirements. No representation or warranty is given and no liability whatsoever is assumed by Zetex with respect to the accuracy or use of such information, or infringement of patents or other intellectual property rights arising from such use or otherwise. Zetex does not assume any legal responsibility or will not be held legally liable (whether in contract, tort (including negligence), breach of statutory duty, restriction or otherwise) for any damages, loss of profit, business, contract, opportunity or consequential loss in the use of these circuit applications, under any circumstances.

Life support

Zetex products are specifically not authorized for use as critical components in life support devices or systems without the express written approval of the Chief Executive Officer of Zetex Semiconductors plc. As used herein:

A. Life support devices or systems are devices or systems which:
   1. are intended to implant into the body

or

   2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labelling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Reproduction

The product specifications contained in this publication are issued to provide outline information only which (unless agreed by the company in writing) may not be used, applied or reproduced for any purpose or form part of any order or contract or be regarded as a representation relating to the products or services concerned.

Terms and Conditions

All products are sold subjects to Zetex' terms and conditions of sale, and this disclaimer (save in the event of a conflict between the two when the terms of the contract shall prevail) according to region, supplied at the time of order acknowledgement.

For the latest information on technology, delivery terms and conditions and prices, please contact your nearest Zetex sales office.

Quality of product

Zetex is an ISO 9001 and TS16949 certified semiconductor manufacturer.

To ensure quality of service and products we strongly advise the purchase of parts directly from Zetex Semiconductors or one of our regionally authorized distributors. For a complete listing of authorized distributors please visit: **www.zetex.com/salesnetwork**

Zetex Semiconductors does not warrant or accept any liability whatsoever in respect of any parts purchased through unauthorized sales channels.

ESD (Electrostatic discharge)

Semiconductor devices are susceptible to damage by ESD. Suitable precautions should be taken when handling and transporting devices. The possible damage to devices depends on the circumstances of the handling and transporting, and the nature of the device. The extent of damage can vary from immediate functional or parametric malfunction to degradation of function or performance in use over time. Devices suspected of being affected should be replaced.

Green compliance

Zetex Semiconductors is committed to environmental excellence in all aspects of its operations which includes meeting or exceeding regulatory requirements with respect to the use of hazardous substances. Numerous successful programs have been implemented to reduce the use of hazardous substances and/or emissions.

All Zetex components are compliant with the RoHS directive, and through this it is supporting its customers in their compliance with WEEE and ELV directives.

Product status key:

"Preview"	Future device intended for production at some point. Samples may be available
"Active"	Product status recommended for new designs
"Last time buy (LTB)"	Device will be discontinued and last time buy period and delivery is in effect
"Not recommended for new designs"	Device is still in production to support existing designs and production
"Obsolete"	Production has been discontinued

Datasheet status key:

"Draft version"	This term denotes a very early datasheet version and contains highly provisional information, which may change in any manner without notice.
"Provisional version"	This term denotes a pre-release datasheet. It provides a clear indication of anticipated performance. However, changes to the test conditions and specifications may occur, at any time and without notice.
"Issue"	This term denotes an issued datasheet containing finalized specifications. However, changes to specifications may occur, at any time and without notice.

Zetex sales offices

Europe

Zetex GmbH
Kustermann-park
Balanstraße 59
D-81541 München
Germany
Telefon: (49) 89 45 49 49 0
Fax: (49) 89 45 49 49 49
europe.sales@zetex.com

Americas

Zetex Inc
700 Veterans Memorial Highway
Hauppauge, NY 11788
USA
Telephone: (1) 631 360 2222
Fax: (1) 631 360 8222
usa.sales@zetex.com

Asia Pacific

Zetex (Asia Ltd)
3701-04 Metroplaza Tower 1
Hing Fong Road, Kwai Fong
Hong Kong
Telephone: (852) 26100 611
Fax: (852) 24250 494
asia.sales@zetex.com

Corporate Headquarters

Zetex Semiconductors plc
Zetex Technology Park, Chadderton
Oldham, OL9 9LL
United Kingdom
Telephone: (44) 161 622 4444
Fax: (44) 161 622 4446
hq@zetex.com

© 2008 Published by Zetex Semiconductors plc

© Zetex Semiconductors plc 2008