ZXGD3107N8

SYNCHRONOUS MOSFET CONTROLLER IN SO-8

Description

ZXGD3107N8 synchronous controller is designed for driving a MOSFET as an ideal rectifier. This is to replace a diode for increasing the power transfer efficiency.

Proportional Gate drive control monitors the reverse voltage of the MOSFET such that if body diode conduction occurs, a positive voltage is applied to the MOSFET's Gate pin. Once the positive voltage is applied to the Gate, the MOSFET switches on allowing reverse current flow. The controllers' output voltage is then proportional to the MOSFET drain-source voltage and this is applied to the Gate via the driver. This action minimizes body diode conduction while enabling a rapid MOSFET turn-off as drain current decays to zero.

Features

- Proportional Gate Drive to Minimize Body Diode Conduction
- Low Standby Power with Quiescent Supply Current < 1mA
- 4.5V Operation Enables Low Voltage Supply
- 40V V_{CC} Rating
- 200V Drain Voltage Rating
- Operation up to 500kHz
- Critical Conduction Mode (CrCM) & Continuous Mode (CCM)
- Compliant with Eco-Design Directive
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony free. "Green" Device (Note 3)**

Applications

Flyback Converters in:

- AC-DC Adaptors
- Set-Top Boxes
- PoE Power Devices

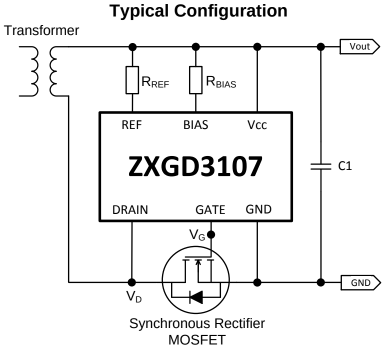
Resonant Converters in:

- Telecoms PSU
- Laptop Adaptors
- Computing Power Supplies – ATX and Server PSU

Mechanical Data

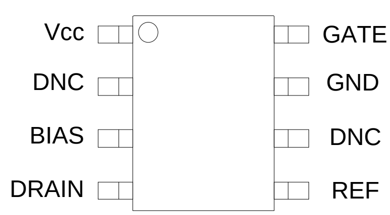
- Case: SO-8
- Case Material: Molded Plastic. "Green" Molding Compound. UL Flammability Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Matte Tin Finish
- Solderable per MIL-STD-202, Method 208 (e3)
- Weight: 0.074 grams (Approximate)

Typical Configuration



SO-8

Top View



Top View
Pin-Out

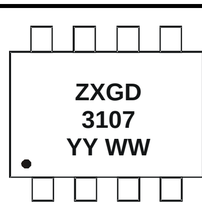
Pin Name	Pin Function
V_{CC}	Power Supply
DNC	Do Not Connect
BIAS	Bias Current
DRAIN	Drain Sense
REF	Reference Current
GND	Power Ground
GATE	Gate Drive

Ordering Information (Note 4)

Product	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
ZXGD3107N8TC	ZXGD3107	13	12	2,500

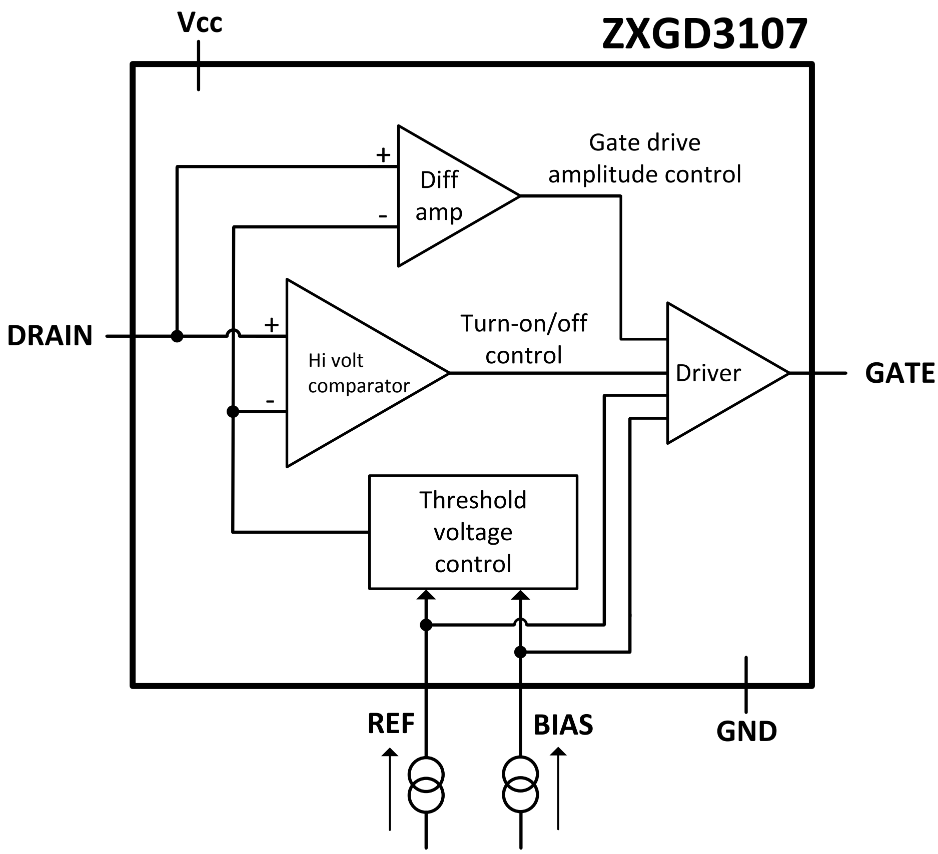
Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. For packaging details, go to our website at http://www.diodes.com.

Marking Information



ZXGD = Product Type Marking Code, Line 1
3107 = Product Type Marking Code, Line 2
YY = Year (ex: 15 = 2015)
WW = Week (01 - 53)

Functional Block Diagram



Pin #	Pin Name	Pin Function and Description
1	Vcc	**Power supply** This supply pin should be closely decoupled to ground with a ceramic capacitor.
2	DNC	**Do Not Connect** Leave pin floating.
3	BIAS	**Bias** Connect this pin to Vcc via R_{BIAS} resistor. Select R_{BIAS} to source 0.56mA into this pin. Refer to Table 1 and 2, in Application Information section.
4	DRAIN	**Drain sense** Connect directly to the synchronous MOSFET drain terminal.
5	REF	**Reference** Connect this pin to Vcc via R_{REF} resistor. Select R_{REF} to source 1.23mA into this pin. Refer to Table 1 and 2, in Application Information section.
6	DNC	**Do not connect** Leave pin floating.
7	GND	**Ground** Connect this pin to the synchronous MOSFET source terminal and ground reference point.
8	GATE	**Gate drive** This pin sinks and sources the I_{SINK} and I_{SOURCE} current to the synchronous MOSFET Gate.

Absolute Maximum Ratings (@T_A = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Supply Voltage, relative to GND	V_{CC}	40	V
Drain Pin Voltage	V_D	-3 to 200	V
Gate Output Voltage	V_G	-3 to V_{CC} + 3	V
Gate Driver Peak Source Current	I_{SOURCE}	4	A
Gate Driver Peak Sink Current	I_{SINK}	9	A
Reference Voltage	V_{REF}	V_{CC}	V
Reference Current	I_{REF}	25	mA
Bias Voltage	V_{BIAS}	V_{CC}	V
Bias Current	I_{BIAS}	100	mA

Thermal Characteristics (@T_A = +25°C, unless otherwise specified.)

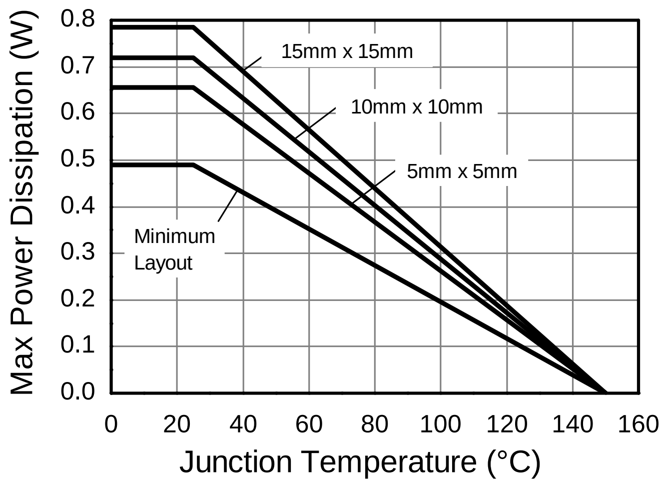
Characteristic		Symbol	Value	Unit
Power Dissipation Linear Derating Factor	(Note 5)	P_D	490 3.92	mW mW/°C
	(Note 6)		655 5.24	
	(Note 7)		720 5.76	
	(Note 8)		785 6.28	
Thermal Resistance, Junction to Ambient	(Note 5)	$R_{\theta JA}$	255	°C/W
	(Note 6)		191	
	(Note 7)		173	
	(Note 8)		159	
Thermal Resistance, Junction to Lead	(Note 9)	$R_{\theta JL}$	55	°C/W
Thermal Resistance, Junction to Case	(Note 10)	$R_{\theta JC}$	45	°C/W
Operating Temperature Range		T_J	-40 to +150	°C
Storage Temperature Range		T_{STG}	-50 to +150	

ESD Ratings (Note 11)

Characteristic	Symbol	Value	Unit	JEDEC Class
Electrostatic Discharge - Human Body Model	ESD HBM	1,500	V	1C
Electrostatic Discharge - Machine Model	ESD MM	200	V	B

Notes:
5. For a device surface mounted on minimum recommended pad layout FR4 PCB with high coverage of single sided 1oz copper, in still air conditions; the device is measured when operating in a steady-state condition.
6. Same as note (5), except pin 1 (V_{CC}) and pin 7 (GND) are both connected to separate 5mm x 5mm 1oz copper heatsinks.
7. Same as note (6), except both heatsinks are 10mm x 10mm.
8. Same as note (6), except both heatsinks are 15mm x 15mm.
9. Thermal resistance from junction to solder-point at the end of each lead on pin 1 (V_{CC}) or pin 7 (GND).
10. Thermal resistance from junction to top of the case.
11. Refer to JEDEC specification JESD22-A114 and JESD22-A115.

Thermal Derating Curve



Derating Curve

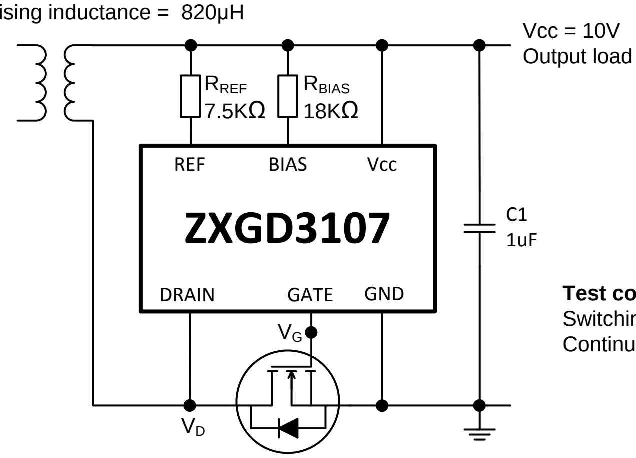
Electrical Characteristics (@T_A = +25°C, unless otherwise specified.)

V_{CC} = 10V; R_{BIAS} = 18kΩ (I_{BIAS} = 0.56mA); R_{REF} = 7.5kΩ (I_{REF} = 1.23mA)

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition	
Input Supply							
Supply to GND Voltage	$V_{CC(ON)}$	40	-	-	V	V_D = -100mV @ Icc = 10µA	
Supply to GND Voltage	$V_{CC(OFF)}$	40	-	-	V	V_D = 1V @ Icc = 10µA	
Drain to GND Voltage	V_D	200	-	-	V	I_D = 1µA	
Quiescent Current	I_Q	-	1.79	-	mA	$V_D \geq$ 0mV	
Gate Driver							
Gate Peak Source Current	I_{SOURCE}	-	2	-	A	Capacitive load: C_L = 20nF	
Gate Peak Sink Current	I_{SINK}	-	7	-			
Detector under DC condition							
Turn-off Threshold Voltage	V_T	-20	-10	0	mV	V_G = 1V	Capacitive load only
Gate Output Voltage	$V_{G(off)}$	-	0.2	0.6	V	$V_D \geq$ 1V	
	V_G	5.0	7.8	-		V_D = -50mV	
		8.0	9.4	-		V_D = -100mV	
Switching Performance							
Turn-on Propagation Delay	$t_{d(rise)}$	-	70	-	ns	Rise and fall measured 10% to 90% Refer to application test circuit below	
Gate Rise Time	t_r	-	175	-			
Turn-off Propagation Delay	$t_{d(fall)}$	-	15	-			
Gate Fall Time	t_f	-	20	-			

Test Circuit for Switching Performance

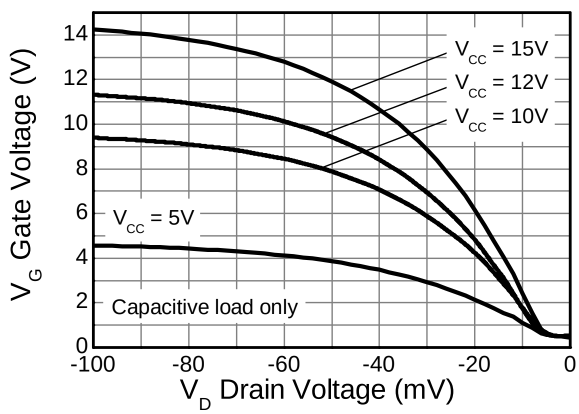
Flyback transformer
Magnetising inductance = 820µH



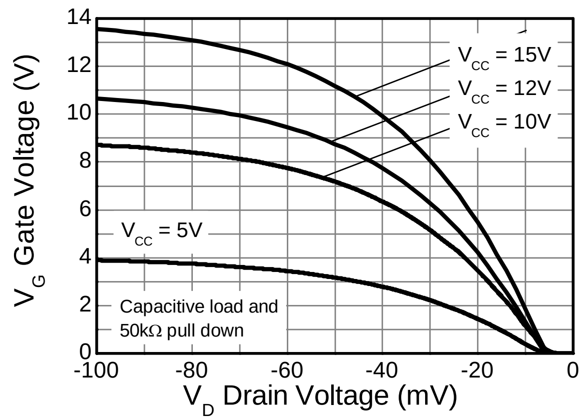
Test conditions
Switching frequency = 100kHz
Continuous conduction mode

MOSFET $Q_{g(tot)}$ = 82nC
$R_{DS(on)}$ = 15mΩ

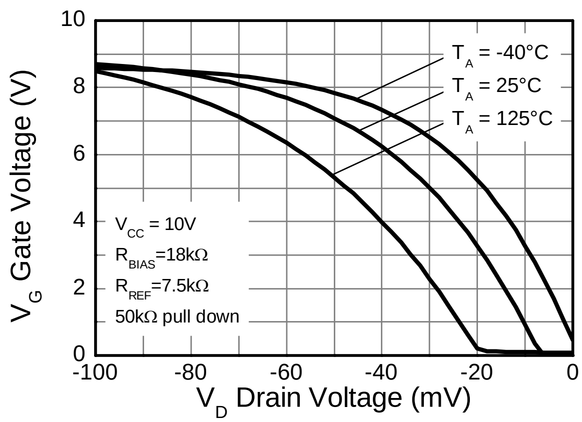
Typical Electrical Characteristics (@T_A = +25°C, unless otherwise specified.)



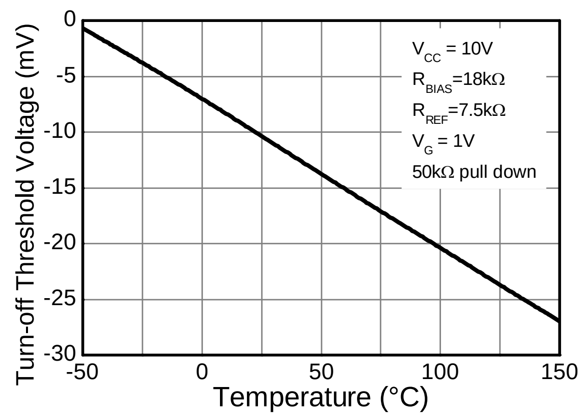
Transfer Characteristic



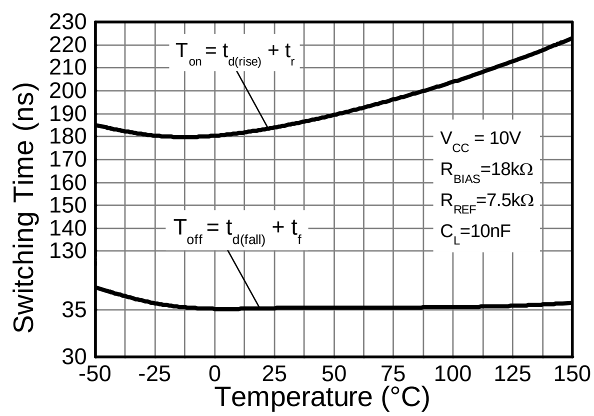
Transfer Characteristic



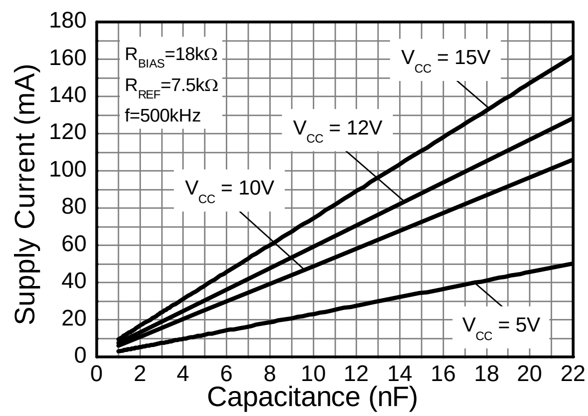
Transfer Characteristic



Turn-off Threshold Voltage vs Temperature

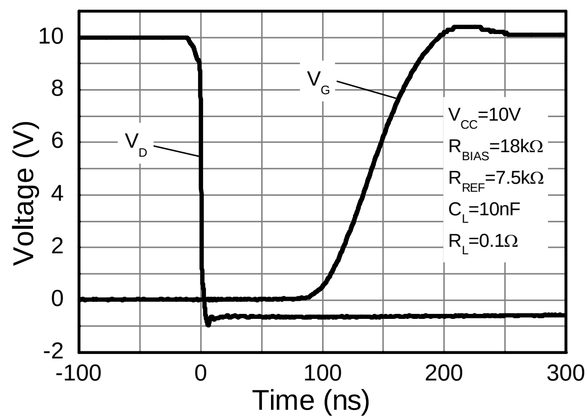


Switching vs Temperature

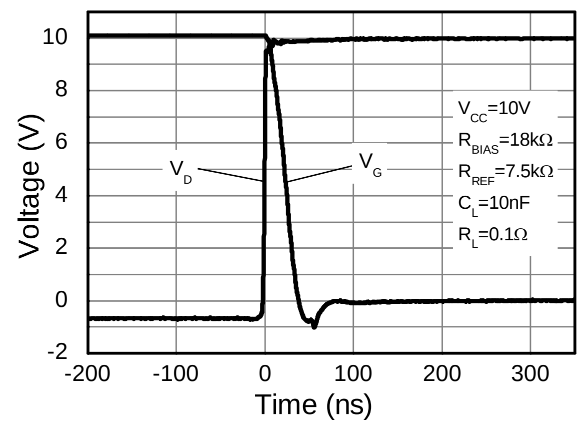


Supply Current vs Capacitive Load

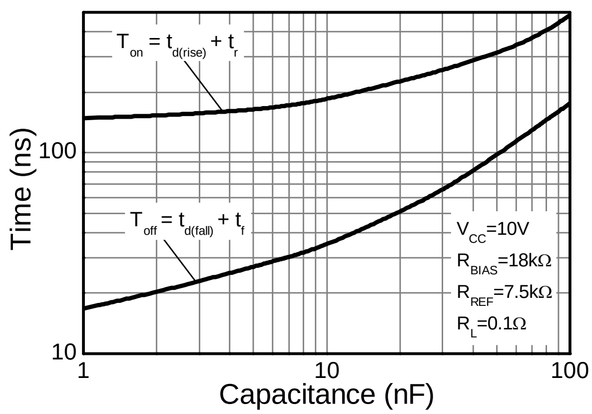
Typical Electrical Characteristics (continued) (@T_A = +25°C, unless otherwise specified.)



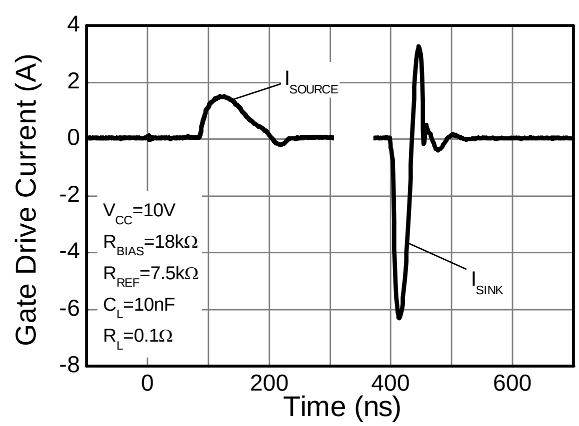
Switch On Speed



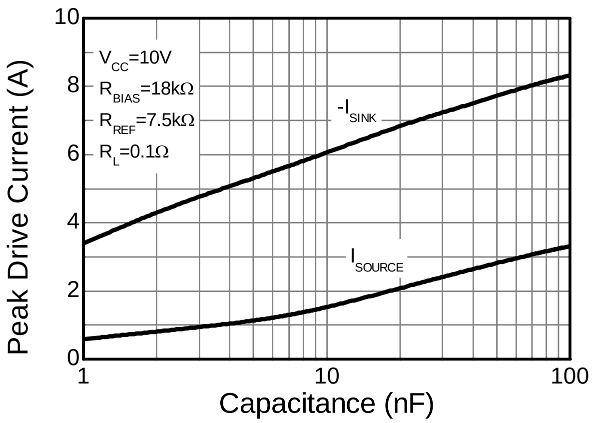
Switch Off Speed



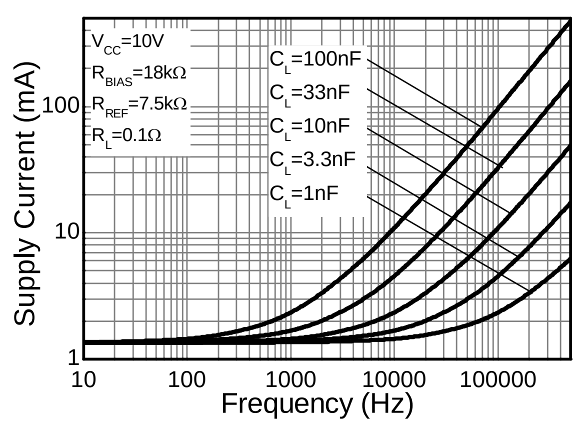
Switching vs Capacitive Load



Gate Drive Current



Gate Current vs Capacitive Load



Supply Current vs Frequency

Application Information

The purpose of the ZXGD3107 is to drive a MOSFET as a low-V_F Schottky diode replacement in isolated AC-DC converter. When combined with a low $R_{DS(ON)}$ MOSFET, the controller can yield significant power-efficiency improvement, while maintaining design simplicity and incurring minimal component count. Figure 1 shows the typical configuration of ZXGD3107 for synchronous rectification in a low output voltage flyback converter.

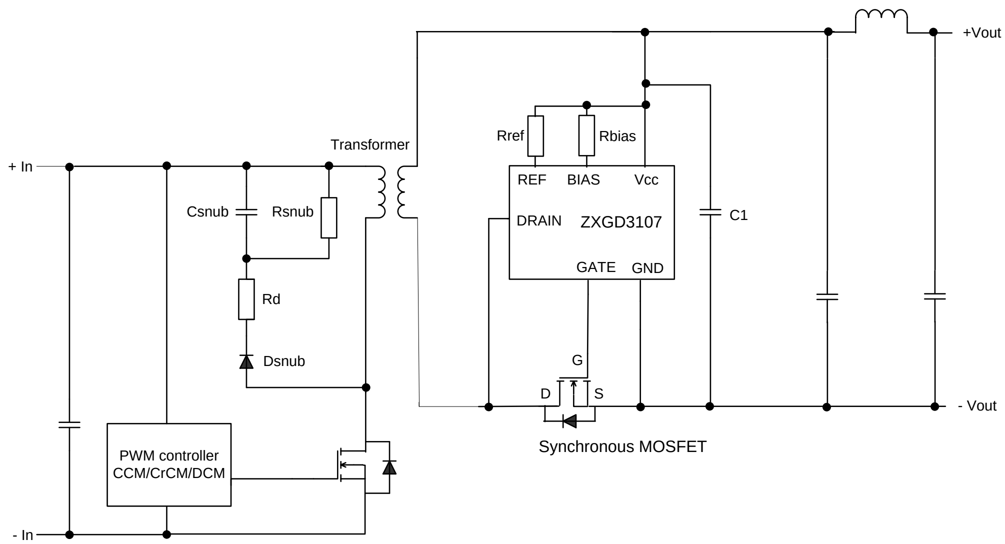


Figure 1 - Typical flyback application schematic

Threshold Voltage and Resistor Setting

Proper selection of external resistors R_{REF} and R_{BIAS} is important for optimum device operation. R_{REF} and R_{BIAS} supply fixed current into the I_{REF} and I_{BIAS} pin of the controller. I_{REF} and I_{BIAS} combines to set the turn-off threshold voltage level, V_T. In order to set V_T to -10mV, the recommended I_{REF} and I_{BIAS} are 1.23mA and 0.56mA respectively.

The values for R_{REF} and R_{BIAS} are selected based on the Vcc voltage. If the Vcc pin is connected to the power converter's output, the resistors should be selected based on the nominal converter's output voltage. Table 1 provides the recommended resistor values for different Vcc voltages to achieve a V_T of -10mV.

Supply, Vcc	**Bias Resistor, R_{BIAS}**	**Reference Resistor, R_{REF}**
5V	9.6kΩ	4kΩ
10V	18kΩ	7.5kΩ
12V	24kΩ	9.6kΩ
15V	30kΩ	12kΩ

Table 1 **–** Recommended resistor values for different Vcc voltages

Application Information (continued)

Functional Descriptions

The operation of the device is described step-by-step with reference to the timing diagram in Figure 2.

1. The detector stage monitors the MOSFET drain-source voltage.

2. When, due to transformer action, the MOSFET body diode is forced to conduct there is a negative voltage on the drain pin due to the body diode forward voltage.

3. When the negative drain voltage crosses the turn-off Threshold voltage V_T, the detector stage outputs a positive voltage with respect to ground after the turn-on delay time $t_{d(fall)}$. This voltage is then fed to the MOSFET driver stage and current is sourced out of the GATE pin.

4. The controller goes into Proportional Gate drive control — the Gate output voltage is proportional to the MOSFET on-resistance-induced drain-source voltage. Proportional Gate drive ensures that MOSFET conducts during majority of the conduction cycle to minimize power loss in the body diode.

5. As the drain current decays linearly toward zero, Proportional Gate drive control reduces the Gate voltage so the MOSFET can be turned off rapidly at zero current crossing. The Gate voltage falls to 1V when the drain-source voltage crosses the detection threshold voltage to minimize reverse current flow.

6. At zero drain current, the controller Gate output voltage is pulled low to $V_{G(off)}$ to ensure that the MOSFET is off.

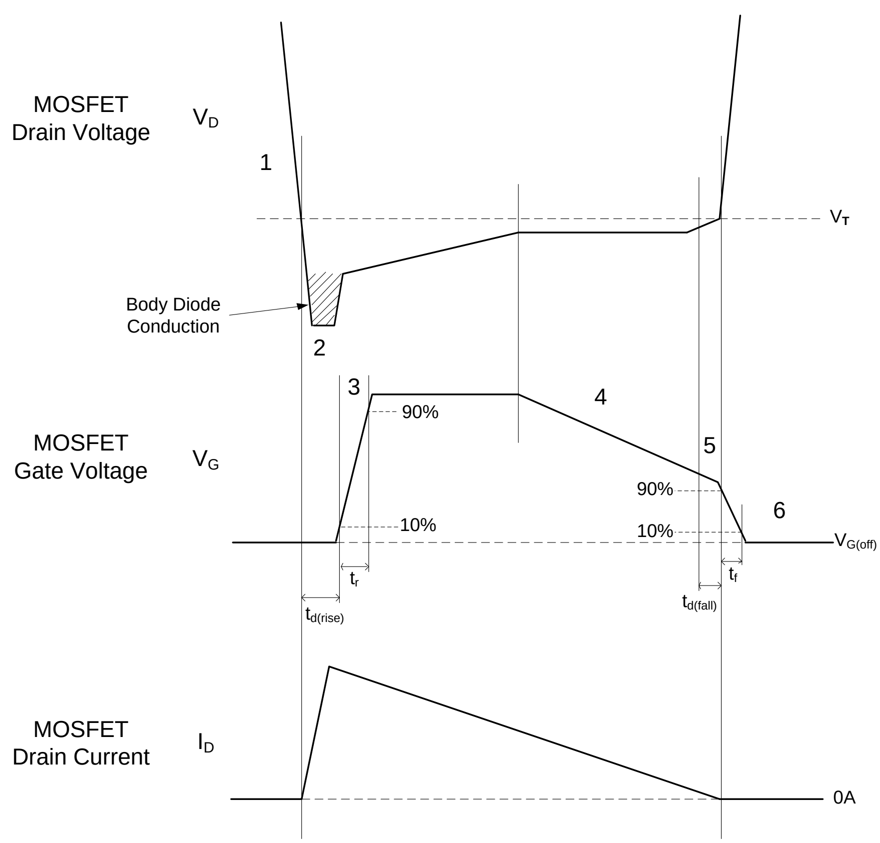


Figure 2 - Timing diagram for a critical conduction mode flyback converter

Application Information (cont.)

Gate Driver

The controller is provided with single channel high-current Gate drive output, capable of driving one or more N-channel power MOSFETs. The controller can operate from Vcc of 4.5V to drive both standard MOSFETs and logic level MOSFETs.

The GATE pin should be as close to the MOSFET's Gate as possible. A resistor in series with GATE pin helps to control the rise time and decrease switching losses due to Gate voltage oscillation. A diode in parallel to the resistor is typically used to maintain fast discharge of the MOSFET's Gate.

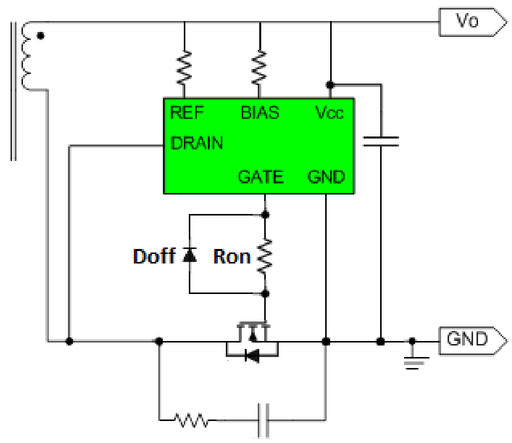


Figure 3 - Typical connection of the ZXGD3107 to the synchronous MOSFET

Quiescent Current Consumption

The quiescent current consumption of the controller is the sum of I_{REF} and I_{BIAS}. For an application that requires ultra-low standby power consumption, I_{REF} and I_{BIAS} can be further reduced by increasing the value of resistor R_{REF} and R_{BIAS}.

Bias Current I_{BIAS}	Ref Current I_{REF}	Bias Resistor R_{BIAS}	Ref Resistor R_{REF}	Quiescent Current I_Q
0.25	0.78	39.8kΩ	11.9kΩ	1.03mA
0.35	0.94	28.4kΩ	9.8kΩ	1.29mA
0.45	1.1	22.1kΩ	8.4kΩ	1.55mA
0.56	1.23	18kΩ	7.5kΩ	1.79mA
0.6	1.34	16.6kΩ	6.9kΩ	1.94mA
0.8	1.6	12.4kΩ	5.8kΩ	2.4mA

Table 2 – Quiescent current consumption for different resistor values at Vcc=10V

I_{REF} also controls the Gate driver peak sink current whilst I_{BIAS} controls the peak source current. At the default current value of I_{REF} and I_{BIAS} of 1.23mA and 0.56mA, the Gate driver is able to provide 2A source and 6A sink current. The Gate current decreases if I_{REF} and I_{BIAS} are reduced. Care must be taken in reducing the controller quiescent current so that sufficient drive current is still delivered to the MOSFET particularly for high-switching frequency application.

Application Information (cont.)

Layout Guidelines

When laying out the PCB, care must be taken in decoupling the ZXGD3107 closely to V_{CC} and ground with 1µF low-ESR, low-ESL X7R type ceramic bypass capacitor. If the converter's output voltage is higher than 40V, a series voltage regulator between the converter's output voltage and the Vcc pin can be used to get a stable Vcc voltage.

GND is the ground reference for the internal high-voltage amplifier as well as the current return for the Gate driver. So the ground return loop should be as short as possible. Sufficient PCB copper area should be allocated to the Vcc and GND pin for heat dissipation especially for high-switching frequency application.

Any stray inductance involved by the load current may cause distortion of the drain-to-source voltage waveform, leading to premature turn-off of the synchronous MOSFET. In order to avoid this issue, drain-voltage sensing should be done as physically close to the drain terminals as possible. The PCB track length between the controller drain pin and MOSFET's terminal should be kept less than 10mm. MOSFET packages with low internal-wire-bond inductance are preferred for high-switching frequency power conversion to minimize body diode conduction.

After the primary MOSFET turns-off, its drain voltage oscillates due to reverse recovery of the snubber diode. These high-frequency oscillations are reflected across the transformer to the drain terminal of the synchronous MOSFET. The synchronous controller senses the drain-voltage ringing, causing its Gate output voltage to oscillate. The synchronous MOSFET cannot be fully enhanced until the drain voltage stabilizes.

In order to prevent this issue, the oscillations on the primary MOSFET can be damped with either a series resistor Rd to the snubber diode or an R-C network across the diode. Both methods reduce the oscillations by softening the snubber diode's reverse recovery characteristic.

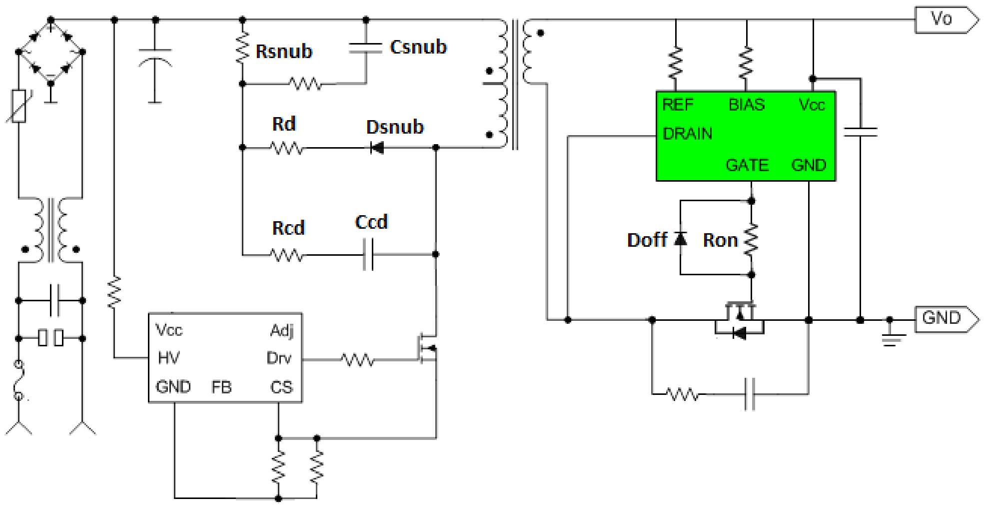
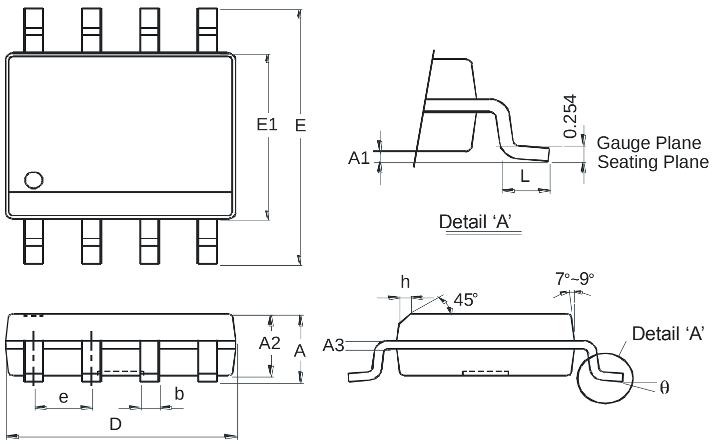


Figure 4 - Primary side snubber network to reduce drain voltage oscillations

Package Outline Dimensions

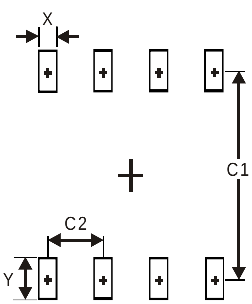
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for the latest version.



SO-8		
Dim	**Min**	**Max**
A	-	1.75
A1	0.10	0.20
A2	1.30	1.50
A3	0.15	0.25
b	0.3	0.5
D	4.85	4.95
E	5.90	6.10
E1	3.85	3.95
e	1.27 Typ	
h	-	0.35
L	0.62	0.82
θ	0°	8°
All Dimensions in mm		

Suggested Pad Layout

Please see AP02001 at http://www.diodes.com/datasheets/ap02001.pdf for the latest version.



Dimensions	Value (in mm)
X	0.60
Y	1.55
C1	5.4
C2	1.27

Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.

Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)
Факс: 8 (812) 320-02-42
Электронная почта: org@eplast1.ru
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.