







Description

The ZXGD3101 is intended to drive MOSFETS configured as ideal diode replacements. The device is comprised of a differential amplifier detector stage and high current driver. The detector 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 detectors' output voltage is then proportional to the MOSFET Drain-Source reverse voltage drop and this is applied to the Gate via the driver. This action provides a rapid turn off as current decays.

Application

- Flyback Converters in:
 - Adaptors
 - LCD Monitors
 - Server PSU's
 - Set Top Boxes
- LLC Converter in:
 - High Power Adaptors
 - LCD TV
 - Street Lighting

Refer to documents: AN54, AN69, DN90, DN91 and DN94 available from the website $% \left({{\left({{{\rm{DN90}}} \right)}_{\rm{A}}} \right)$

Features

- Turn-off propagation delay 15ns and turn-off time 20ns.
- Suitable for Discontinuous Mode (DCM), Critical Conduction Mode (CrCM) and Continuous Mode (CCM) operation
- Compliant with Energy Star V2.0 and European Code of Conduct V3
- Halogen Free part
- 5-15V Vcc range

Mechanical Data

- Case: SO-8
- Marking Information: See Page 13





Pin out details

Typical Configuration

Ordering Information

| Product | Status | Package | Marking | Reel size (inches) | Tape width (mm) | Quantity per reel |
|--------------|--------|---------|----------|--------------------|-----------------|-------------------|
| ZXGD3101N8TC | Active | SO-8 | ZXGD3101 | 13 | 12 | 2500 |







Maximum Ratings

| Parameter | Symbol | Limit | Unit |
|--|-------------------|---------------------------|------|
| Supply voltage (Note 1) | V _{CC} | 15 | V |
| Continuous Drain pin voltage (Note 1) | VD | -3 to180 | V |
| GATEH and GATEL output Voltage (Note 1) | V _G | -3 to V _{CC} + 3 | V |
| Driver peak source current | ISOURCE | 4 | А |
| Driver peak sink current | I _{SINK} | 7 | А |
| Reference current | I _{REF} | 25 | mA |
| Bias voltage | V _{BIAS} | V _{cc} | V |
| Bias current | I _{BIAS} | 100 | mA |
| Power dissipation at $T_A = 25^{\circ}C$ | P _D | 490 | mW |
| Operating junction temperature | TJ | -40 to +150 | °C |
| Storage temperature | T _{STG} | -50 to +150 | °C |

Thermal Characteristics

| Parameter | Symbol | Value | Unit |
|------------------------------|------------------|-------|------|
| Junction to ambient (Note 2) | R _{0JA} | 255 | °C/W |
| Junction to lead (Note 3) | R _{0IA} | 120 | °C/W |

ESD Rating

| Model | Rating | Unit | |
|------------|--------|------|--|
| Human Body | 4000 | V | |
| Machine | 400 | V | |

Notes:

All voltages are relative to GND pin
 Mounted on minimum 1oz weight copper on FR4 PCB in still air conditions.

3. Output Drivers - Junction to solder point at end of the lead 5 and 6







| Electrical Characteristics @T _A = 25°C, V _{CC} = 10V, R _{BIAS} =1.8kΩ, R _{REF} =3kΩ | | | | | | | | |
|---|---------------------|---|------|-------|------|------|--|--|
| Parameter | Symbol | Conditions | Min. | Тур. | Max. | Unit | | |
| Input and supply characteristics | | | | | | | | |
| | | V _{DRAIN} ≤ -200m V | - | 3 | - | m۵ | | |
| Operating current | IOP | V _{DRAIN} ≥ 0V | - | - 8 - | | mA | | |
| Gate Driver | | | | | | | | |
| Turn-off Threshold Voltage(Note 4) | VT | V _G = 1V, (Note 5) | -45 | -16 | 0 | mV | | |
| | V _{G(off)} | V _{DRAIN} ≥ 0V, (Note 5) | - | 0.6 | 1 | + | | |
| | | V _{DRAIN} = -60mV, (Note 6) | 5.0 | 7.5 | - | | | |
| GATE output voltage (Note 4) | | V _{DRAIN} = -80mV, (Note 6) | 7.0 | 8.5 | - | - V | | |
| | V _G | V _{DRAIN} = -100mV, (Note 6) | 8.4 | 9 | - | | | |
| | | V _{DRAIN} ≤ -140mV, (Note 6) | 9.2 | 9.4 | - | | | |
| | | $V_{\text{DRAIN}} \leq -200 \text{mV}$, (Note 6) | 9.3 | 9.5 | - | | | |
| GATEH peak source current | I _{SOURCE} | V _{GH} = 1V | | 2.5 | - | А | | |
| GATEL peak sink current | I _{SINK} | $V_{GL} = 5V$ | | 2.5 | - | А | | |
| Turn on Propagation delay | t _{d1} | | | 525 | | ns | | |
| Turn off Propagation delay | t _{d2} | C _L = 2.2nF, (Notes 6 and 7) | | 15 | | ns | | |
| Gate rise time | tr | | | 305 | | ns | | |
| Gate fall time | t _f | | | 20 | | ns | | |

Notes: 4. GATEH connected to GATEL

5. $R_H = 100 k\Omega$, $R_L = O/C$

6. $R_L = 100k\Omega$, $R_H = O/C$ 7. Refer to Fig 6: test circuit and Fig 7: timing diagram on Page 12







Schematic Symbol and Pin Out Details



| Pin No. | Symbol | Description and function |
|---------|-----------------|--|
| 1 | NC | No connection This pin can be connected to GND |
| 2 | REF | Reference This pin is connected to V_{CC} via resistor, R_{REF} . R_{REF} should be selected to source approximately 3mA into this pin. (Note 8) |
| 3 | GATEL | Gate turn off This pin sinks current, I _{SINK} , from the synchronous MOSFET Gate. |
| 4 | GATEH | Gate turn on This pin sources current, I _{SOURCE} , to the synchronous MOSFET Gate. |
| 5 | V _{cc} | Power Supply This is the supply pin. It is recommended to decouple this point to ground closely with a ceramic capacitor. |
| 6 | GND | Ground This is the ground reference point. Connect to the synchronous MOSFET Source terminal. |
| 7 | BIAS | Bias This pin is connected to V_{CC} via resistor, R_{BIAS} . R_{BIAS} should be selected to source 1.6 times I_{REF} into this pin. (Note 9) |
| 8 | DRAIN | Drain connection This pin connects directly to the synchronous MOSFET Drain terminal. |

 Notes:
 8. REF pin should be assumed to be at GND +0.7V.
 9. BIAS pin should be assumed to be at GND +0.3V.

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Operation

Normal Operation

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

1. The detector monitors the MOSFET Drain-Source voltage.

2. When, due to transformer action, the MOSFET body diode is forced to conduct there is approximately -0.6V on the Drain pin.

3. The detector outputs a positive voltage with respect to ground, this voltage is then fed to the MOSFET driver stage and current is sourced out of the GATEH pin.

4. The current out of the GATEH pin is sourced into the synchronous MOSFET Gate to turn the device on.

5. The GATEH output voltage is now proportional to the Drain-Source voltage drop across the MOSFET due to the current flowing through the MOSFET.

6. MOSFET conduction continues until the drain current reaches zero.

7. At zero current the detector output voltage is zero and the synchronous MOSFET Gate voltage is pulled low by the GATEL, turning the device off.



MOSFET Gate Current









1a) Continuous Conduction Mode (CCM)







1c) Discontinuous Conduction Mode (DCM)





A Product Line of Diodes Incorporated



SYNCHRONOUS RECTIFIER CONTROLLER



Typical Characteristics







Typical Characteristics











Component Selection

It is advisable to decouple the ZXGD3101 closely to V_{CC} and ground due to the possibility of high peak gate currents with C1 in Figure 2.

The proper selection of external resistors R_{REF} and R_{BIAS} is important to the optimum device operation. Select a value for resistor R_{REF} to give a reference current, I_{REF} , of ~3mA. The value of R_{BIAS} must then be 0.6 times the value of R_{REF} giving a bias current, I_{BIAS} , of ~1.6 times I_{REF} . This provides a recommended typical offset voltage of ~20mV.

External gate resistors are optional. They can be inserted to control the rise times which may help with EMI issues, power supply consumption issues or dissipation within the part.

 $R_{REF} = (V_{CC} - 0.7V) / 0.003$

 $R_{BIAS} = (V_{CC} - 0.3V) / 0.005$

Layout considerations

The Gate pins should be as close to the MOSFET Gate as possible. Also the ground return loop should be as short as possible. The decoupling capacitor should be close to the V_{cc} and Ground pin, and should be a X7R type.

For more detailed information refer to application note AN54..









Figure 2 Example connection for low side synchronous rectification



Figure 3: Example connection for high side synchronous rectification









Figure 4: Example connections for LLC converter

















Figure 7: Timing Diagram







Package Outline and Dimensions



Suggested Pad Layout



| Dimensions | Value (in mm) |
|------------|---------------|
| Х | 0.60 |
| Y | 1.55 |
| C1 | 5.4 |
| C2 | 1.27 |

Marking Information



 $\begin{aligned} & ZXGD3101 = Product Type Marking Code \\ & YM = Date Code Marking \\ & Y = Year (ex. W = 2009) \\ & M = Month (ex. 9 = September) \end{aligned}$

| Date Code Key | | | | | | | | | | | | |
|---------------|-----|-----|------|-----|------|-----|-----|------|-----|------|-----|------|
| Year | 200 | 9 | 2010 | | 2011 | 20 | 12 | 2013 | | 2014 | 2 | 2015 |
| Code | W | | Х | | Y | 2 | Ζ | А | | В | | С |
| | | | | • | | • | | | • | | | |
| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | N | D |







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