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.

Features
- Turn-off propagation delay 15ns and turn-off time 20ns
- Suitable for Discontinuous Mode (DCM), Critical Conduction Mode (CrCM) and Continuous conduction mode (CCM) operation
- Compliant with Energy Star V2.0 and European Code of Conduct V3
- Low component count
- Halogen free
- 5-15V $V_{CC}$ range

Pin out detail

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.

Applications
Flyback converters in:
- Adaptors
- LCD monitors
- Server PSU’s
- Set top boxes

Refer to documents; AN54, DN90, DN91 and DN94 available from the website

Typical configuration

Ordering information

<table>
<thead>
<tr>
<th>Device</th>
<th>Status</th>
<th>Package</th>
<th>Part Mark</th>
<th>Reelsize (inches)</th>
<th>Tape width (mm)</th>
<th>Quantity per reel</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZXGD3101T8TA</td>
<td>Active</td>
<td>SM8</td>
<td>ZXGD3101</td>
<td>7</td>
<td>12</td>
<td>1000</td>
</tr>
</tbody>
</table>
## Absolute maximum ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Limit</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage¹</td>
<td>$V_{CC}$</td>
<td>15</td>
<td>V</td>
</tr>
<tr>
<td>Continuous Drain pin voltage¹</td>
<td>$V_D$</td>
<td>-3 to 180</td>
<td>V</td>
</tr>
<tr>
<td>GATEH and GATEL output Voltage¹</td>
<td>$V_G$</td>
<td>-3 to $V_{CC}$ + 3</td>
<td>V</td>
</tr>
<tr>
<td>Driver peak source current</td>
<td>$I_{SOURCE}$</td>
<td>4</td>
<td>A</td>
</tr>
<tr>
<td>Driver peak sink current</td>
<td>$I_{SINK}$</td>
<td>7</td>
<td>A</td>
</tr>
<tr>
<td>Reference current</td>
<td>$I_{REF}$</td>
<td>25</td>
<td>mA</td>
</tr>
<tr>
<td>Bias voltage</td>
<td>$V_{BIAS}$</td>
<td>$V_{CC}$</td>
<td>V</td>
</tr>
<tr>
<td>Bias current</td>
<td>$I_{BIAS}$</td>
<td>100</td>
<td>mA</td>
</tr>
<tr>
<td>Power dissipation at $T_A$ =25°C</td>
<td>$P_D$</td>
<td>500</td>
<td>mW</td>
</tr>
<tr>
<td>Operating junction temperature</td>
<td>$T_J$</td>
<td>-40 to +150</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$T_{stg}$</td>
<td>-50 to +150</td>
<td>°C</td>
</tr>
</tbody>
</table>

**NOTES:**
1. All voltages are relative to GND pin

## Thermal resistance

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junction to ambient (*)</td>
<td>$R_{BA}$</td>
<td>250</td>
<td>°C/W</td>
</tr>
<tr>
<td>Junction to lead (†)</td>
<td>$R_{BA}$</td>
<td>54</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

**NOTES:**
(*): Mounted on minimum 1oz copper on FR4 PCB in still air conditions
(†): Output Drivers - Junction to solder point at end of the lead 5 and 6

## ESD Rating

<table>
<thead>
<tr>
<th>Model</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human body</td>
<td>4,000</td>
<td>V</td>
</tr>
<tr>
<td>Machine</td>
<td>400</td>
<td>V</td>
</tr>
</tbody>
</table>
### Electrical characteristics at $T_A = 25^\circ C$

$V_{CC} = 10V$; $R_{BIAS} = 1.8k\Omega$; $R_{REF}=3k\Omega$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input and supply characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating current</td>
<td>$I_{OP}$</td>
<td>$V_{DRAIN} \leq -200mV$</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DRAIN} \geq 0V$</td>
<td>-</td>
<td>8</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td><strong>Gate Driver</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn-off Threshold Voltage $^{(**)}$</td>
<td>$V_T$</td>
<td>$V_G = 1V$, $^{(*)}$</td>
<td>-45</td>
<td>-16</td>
<td>0</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{G(\text{off})}$</td>
<td>-</td>
<td>0.6</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_G$</td>
<td>$V_{DRAIN} \geq 0V$, $^{(e)}$</td>
<td>-</td>
<td>6.0</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DRAIN} = -60mV$, $^{(i)}$</td>
<td>6.0</td>
<td>7.5</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DRAIN} = -80mV$, $^{(i)}$</td>
<td>7.0</td>
<td>8.5</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DRAIN} = -100mV$, $^{(i)}$</td>
<td>8.4</td>
<td>9</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DRAIN} \leq -140mV$, $^{(i)}$</td>
<td>9.2</td>
<td>9.4</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DRAIN} \leq -200mV$, $^{(i)}$</td>
<td>9.3</td>
<td>9.5</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>GATEH peak source current</td>
<td>$I_{SOURCE}$</td>
<td>$V_{GH} = 1V$</td>
<td>2.5</td>
<td>-</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>GATEL peak sink current</td>
<td>$I_{SINK}$</td>
<td>$V_{GL} = 5V$</td>
<td>2.5</td>
<td>-</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Turn on Propagation delay</td>
<td>$t_{d1}$</td>
<td></td>
<td>525</td>
<td>ns</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Turn off Propagation delay</td>
<td>$t_{d2}$</td>
<td>$C_L = 2.2nF$, $^{(i)}$ $^{(a)}$</td>
<td>15</td>
<td>ns</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Gate rise time</td>
<td>$t_r$</td>
<td></td>
<td>305</td>
<td>ns</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Gate fall time</td>
<td>$t_f$</td>
<td></td>
<td>20</td>
<td>ns</td>
<td>ns</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

$^{(**)}$ GATEH connected to GATEL
$^{(*)}$ $R_H = 100K\Omega$, $R_L = 0/C$
$^{(e)}$ $R_E = 100K\Omega$, $R_{BIAS} = 0/C$
$^{(i)}$ Refer to Fig 4; Test circuit and Fig 5; Timing diagram on page 11
Schematic symbol and pin description

![Diagram](ZXGD3101T8)

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Description and function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NC</td>
<td>No connection&lt;br&gt;This pin can be connected to GND</td>
</tr>
<tr>
<td>2</td>
<td>REF</td>
<td>Reference&lt;br&gt;This pin is connected to VCC via resistor, RREF. RREF should be selected to source ~3mA into this pin. See note 1</td>
</tr>
<tr>
<td>3</td>
<td>GATEL</td>
<td>Gate turn off&lt;br&gt;This pin sinks current, ISINK, from the synchronous MOSFET Gate.</td>
</tr>
<tr>
<td>4</td>
<td>GATEH</td>
<td>Gate turn on&lt;br&gt;This pin sources current, ISOURCE, to the synchronous MOSFET Gate.</td>
</tr>
<tr>
<td>5</td>
<td>VCC</td>
<td>Power Supply&lt;br&gt;This is the supply pin. It is recommended to decouple this point to ground closely with a ceramic capacitor.</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
<td>Ground&lt;br&gt;This is the ground reference point. Connect to the synchronous MOSFET Source terminal.</td>
</tr>
<tr>
<td>7</td>
<td>BIAS</td>
<td>Bias&lt;br&gt;This pin is connected to VCC via resistor, RBIAS. RBIAS should be selected to source 1.6 times IREF into this pin. See note 1</td>
</tr>
<tr>
<td>8</td>
<td>DRAIN</td>
<td>Drain connection&lt;br&gt;This pin connects directly to the synchronous MOSFET Drain terminal.</td>
</tr>
</tbody>
</table>

NOTES:

1. BIAS and REF pins should be assumed to be at GND+0.7V
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.
NOT RECOMMENDED FOR NEW DESIGN
USE ZXGD3101N8

Fig 1a: Continuous Conduction Mode (CCM)

Fig 1b: Critical Conduction Mode (CrCM)

Fig 1c: Discontinuous Conduction Mode (DCM)

Figure 1. Typical waveforms
Typical characteristics

Transfer Characteristic

- $V_G$ Gate Voltage (V)
- $V_D$ Drain Voltage (V)

$V_C = 10V$
$V_B = 5mA$
$I_{REF} = 3mA$
$R_{LOAD} = 1k\Omega$

$T = +40^\circ C$
$T = 25^\circ C$
$T = 125^\circ C$

Transfer Characteristic

- $V_G$ Gate Voltage (V)
- $V_D$ Drain Voltage (V)

$I_{BAS} = 5mA$
$I_{REF} = 3mA$
$R_{LOAD} = 1k\Omega$
$T = 25^\circ C$

Transfer Characteristic

- $V_G$ Gate Voltage (V)
- $V_D$ Drain Voltage (V)

$V_C = 10V$
$I_{BAS} = 5mA$
$I_{REF} = 2mA$
$I_{REF} = 2.5mA$
$I_{REF} = 3mA$
$I_{REF} = 3.5mA$
$I_{REF} = 4mA$

Transfer Characteristic

- $V_G$ Gate Voltage (V)
- $V_D$ Drain Voltage (V)

$V_C = 10V$
$I_{BAS} = 6mA$
$I_{BAS} = 5mA$
$I_{BAS} = 4.5mA$
$I_{BAS} = 4mA$

Bias Current vs Reference Current

- $I_{REF}$ Reference Current (mA)
- $I_{BAS}$ Bias Current (mA)

Turn-off offset voltage

<table>
<thead>
<tr>
<th>$V_D$</th>
<th>$I_{REF}$ Reference Current (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10mV$</td>
<td>2.5 mA</td>
</tr>
<tr>
<td>$20mV$</td>
<td>2 mA</td>
</tr>
</tbody>
</table>

Resistor Ratio $R_{RES}/R_{RES}$ vs Bias Current

- $V_D = 1V$
- $I_{REF} = 1mA$

Bias Resistor vs Reference Resistor

- $I_{BAS}$ Bias Current (mA)

Turn-off offset voltage

<table>
<thead>
<tr>
<th>$V_D$</th>
<th>$I_{BAS}$ Bias Current (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10mV$</td>
<td>2.5 mA</td>
</tr>
<tr>
<td>$20mV$</td>
<td>2 mA</td>
</tr>
</tbody>
</table>
Typical characteristics

**Drain Sense Voltage vs Temperature**

- **Turn-off offset voltage**
  - Set to ~0mV at 25°C
  - Set to ~20mV at 25°C

- **Normalized Current Gain**
  - Source Current
    - $V_{ds} = 10V$
    - $V_s = 1V$
  - $I_{source} = 2.5A$

- **Sink Current**
  - $V_{ds} = 10V$
  - $V_s = 5V$
  - $I_{source} = 2.5A$

**Switch On Speed**

- $V_D$
  - $V_s$

**Switch Off Speed**

- $V_D$
  - $V_s$

**Switching vs Temperature**

- $F = 100kHz$
  - $V_{ds} = 10V$
  - $R_{ds} = 1.8\,\Omega$
  - $R_{es} = 3k\,\Omega$
  - $C_{es} = 2.2nF$
  - $R_{es} = 1k\,\Omega$

**Supply Current vs Temperature**

- $F = 100kHz$
  - $V_{ds} = 10V$
  - $R_{ds} = 1.8\,\Omega$
  - $R_{es} = 3k\,\Omega$
  - $C_{es} = 2.2nF$
  - $R_{es} = 100k\,\Omega$
Typical characteristics

**Supply Current vs Capacitive Load**

- $V_{cc}=15V$
- $V_{cc}=12V$
- $V_{cc}=10V$
- $V_{cc}=8V$

$F=100kHz$, $R_{REF}=1.8k\Omega$

**Supply Current vs Frequency**

- $V_{cc}=10V$
- $R_{REF}=1.5k\Omega$
- $R_{REF}=3k\Omega$
- $R_{REF}=100k\Omega$

$C_{L}=10nF$
$C_{L}=4.7nF$
$C_{L}=2.2nF$
$C_{L}=1nF$

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 $C_1$ 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 $R_{REF}$ to give 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.

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

$$R_{BIAS} = (V_{CC} - 0.7V) / 0.005$$

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: Test circuit

Figure 5: Timing diagram
NOT RECOMMENDED FOR NEW DESIGN
USE ZXGD3101N8

Package information - SM8 (Surface mounted, 8 pin package)

<table>
<thead>
<tr>
<th>DIM</th>
<th>Millimeters</th>
<th>Inches</th>
<th>DIM</th>
<th>Millimeters</th>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.7</td>
<td>-</td>
<td>e1</td>
<td>4.59</td>
<td>-</td>
</tr>
<tr>
<td>A1</td>
<td>0.1</td>
<td>-</td>
<td>e2</td>
<td>1.53</td>
<td>-</td>
</tr>
<tr>
<td>b</td>
<td>0.7</td>
<td>-</td>
<td>He</td>
<td>6.7</td>
<td>7.3</td>
</tr>
<tr>
<td>c</td>
<td>0.32</td>
<td>-</td>
<td>Lp</td>
<td>0.035</td>
<td>-</td>
</tr>
<tr>
<td>D</td>
<td>6.3</td>
<td>6.7</td>
<td>α</td>
<td>15°</td>
<td>-</td>
</tr>
<tr>
<td>E</td>
<td>3.3</td>
<td>3.7</td>
<td>β</td>
<td>10°</td>
<td>-</td>
</tr>
</tbody>
</table>

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

Soldering footprint
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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 in effect

“Not recommended for new designs” Device is still in production to support existing designs and production

“Obsoleted” 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.

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