## Description

The ZXGD3102 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.

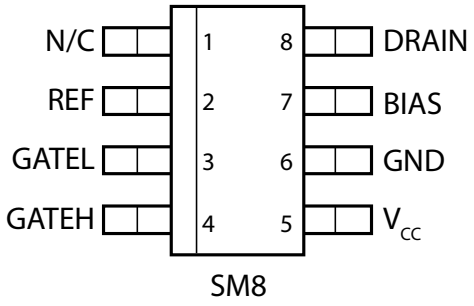
### Features

- Turn-off time typically 160ns
- 180V blocking voltage
- Proportional Gate drive
- 2A Source, 5A Sink driver
- $V_{CC}$ Range 5-15V
- Low component count

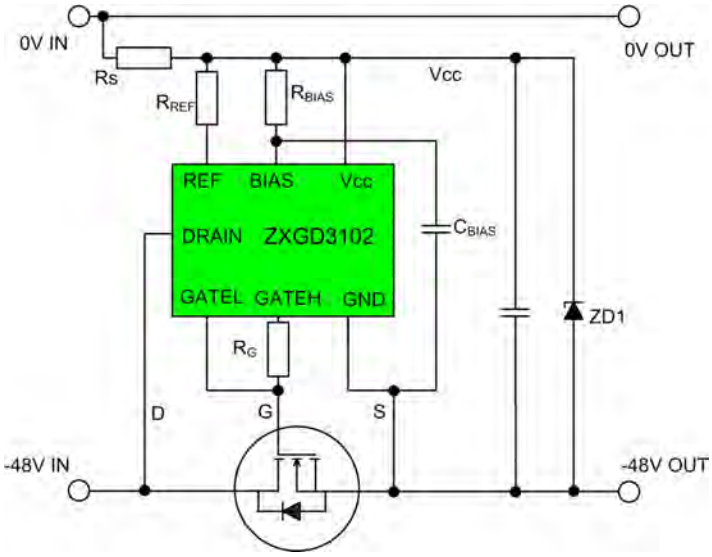
### Applications

- High Side OR'ing diode replacement for Servers, Computer
- Low Side OR'ing diode replacement for Telecoms
- Ideal diode applications

### Pin out details




### Typical Configuration




### Ordering information

| Device | Status | Package | Part Mark | Reel size (inches) | Tape width (mm) | Quantity per reel |
|---|---|---|---|---|---|---|
| ZXGD3102T8TA | Active | SM8 | ZXGD3102 | 7 | 12 | 1000 |

## Absolute maximum ratings

| Parameter | Symbol | Limit | Unit |
|---|---|---|---|
| Supply voltage[1] | $V_{CC}$ | 15 | V |
| Continuous Drain pin voltage[1] | $V_D$ | -3 to180 | V |
| GATEH and GATEL output Voltage[1] | $V_G$ | -3 to $V_{CC}$ + 3 | V |
| Driver peak source current | $I_{SOURCE}$ | 4 | A |
| Driver peak sink current | $I_{SINK}$ | 7 | A |
| 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°C | $P_D$ | 500 | mW |
| Operating junction temperature | $T_j$ | -40 to +150 | °C |
| Storage temperature | $T_{stg}$ | -50 to +150 | °C |

Notes:

1. All voltages are relative to GND pin

## Thermal resistance

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Junction to ambient (*) | $R_{\theta JA}$ | 250 | °C/W |
| Junction to case (†) | $R_{\theta JC}$ | 54 | °C/W |

## Notes:

(*) Mounted on minimum 1oz copper on FR4 PCB in still air conditions

(†) Output Drivers – Junction to solder point at the end of the lead 5 and 6

ESD Rating

| Model | Rating | Unit |
|---|---|---|
| Human body | 4,000 | V |
| Machine | 400 | V |

DC Electrical characteristics at $T_A$ = 25°C;
$V_{CC}$ = 10V; $R_{BIAS}$ = 3.3kΩ ; $R_{REF}$=3.9kΩ

| Parameter | Symbol | Conditions | Min. | Typ | Max. | Unit |
|---|---|---|---|---|---|---|
| **Input and supply characteristics** | | | | | | |
| Operating current | $I_{OP}$ | $V_{DRAIN}$ ≤ -100m V | - | 2.4 | - | mA |
| | | $V_{DRAIN}$ ≥ 0V | - | 5.2 | - | |
| **Gate Driver** | | | | | | |
| Turn-off Threshold Voltage(**) | $V_T$ | $V_G$ = 1V, (*) | -50 | -24 | 0 | mV |
| GATE output voltage (**) | $V_{G(off)}$ | $V_{DRAIN}$ ≥ 0V, (*) | - | 0.58 | 1 | V |
| | $V_G$ | $V_{DRAIN}$ = -60mV, (†) | 4.1 | 7 | - | |
| | | $V_{DRAIN}$ = -80mV, (†) | 6.5 | 8.5 | - | |
| | | $V_{DRAIN}$ = -100mV, (†) | 8.0 | 9 | - | |
| | | $V_{DRAIN}$ = -140mV, (†) | 8.5 | 9.4 | - | |
| GATEH peak source current | $I_{SOURCE}$ | $V_{GH}$ = 1V | | 2 | - | A |
| GATEL peak sink current | $I_{SINK}$ | $V_{GL}$ = 5V | 5 | - | - | A |

DC Electrical Characteristics at $T_A$ = 25°C;
$V_{CC}$ = 10V; $R_{BIAS}$ = 3.9kΩ ; $R_{REF}$=3.9kΩ

| Parameter | Symbol | Conditions | Min. | Typ | Max. | Unit |
|---|---|---|---|---|---|---|
| **Input and supply characteristics** | | | | | | |
| Operating current | $I_{OP}$ | $V_{DRAIN}$ ≤ -100m V | - | 2.4 | - | mA |
| | | $V_{DRAIN}$ ≥ 0V | - | 4.8 | - | |
| **Gate Driver** | | | | | | |
| Turn-off Threshold Voltage(**) | $V_T$ | $V_G$ = 1V, (*) | -55 | -29 | 0 | mV |
| GATE output voltage (**) | $V_{G(off)}$ | $V_{DRAIN}$ ≥ 0V, (*) | - | 0.57 | 1 | V |
| | $V_G$ | $V_{DRAIN}$ = -60mV, (†) | 3.5 | 6.5 | - | |
| | | $V_{DRAIN}$ = -80mV, (†) | 6.5 | 8.5 | - | |
| | | $V_{DRAIN}$ = -100mV, (†) | 8.0 | 8.8 | - | |
| | | $V_{DRAIN}$ = -140mV, (†) | 8.5 | 9.4 | - | |
| GATEH peak source current | $I_{SOURCE}$ | $V_{GH}$ = 1V | | 2 | - | A |
| GATEL peak sink current | $I_{SINK}$ | $V_{GL}$ = 5V | 5 | - | - | A |

**Notes:**

**(**)** GATEH connected to GATEL

**(*)** $R_H$ = 100kΩ, $R_L$ = O/C

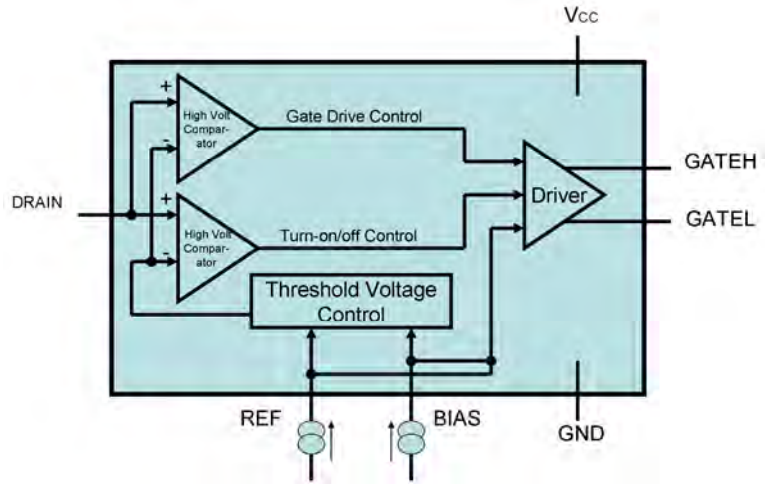
**(†)** $R_L$ = 100kΩ, $R_H$ = O/C

Transient Electrical Characteristics at $T_A$ = 25°C;
$V_{CC}$ = 10V; $R_{BIAS}$ = 3.3 kΩ to 3.9kΩ ; $R_{REF}$=3.9kΩ

| | | | | | | |
|---|---|---|---|---|---|---|
| Turn on Propagation delay | $t_{d1}$ | $C_L$ = 10nF,, | | 880 | | ns |
| Turn off Propagation delay | $t_{d2}$ | | | 52 | | ns |
| Gate rise time | $t_r$ | $C_{BIAS}$ = 2.2nF, | | 5100 | | ns |
| Gate fall time | $t_f$ | (†)(a) | | 110 | | ns |

**(a) Refer to Fig 4: test circuit and Fig 5: timing diagram**

## Schematic Symbol and Pin Out Details




| Pin No. | Symbol | Description and function |
|---|---|---|
| 1 | **NC** | **No connection**<br>This pin can be connected to GND |
| 2 | **REF** | **Reference**<br>This pin is connected to $V_{CC}$ via resistor, $R_{REF}$. $R_{REF}$ should be selected to source approximately 2.4mA into this pin. See Note 1 |
| **3** | **GATEL** | **Gate turn off**<br>This pin sinks current, $I_{SINK}$, from the OR'ing MOSFET Gate. |
| 4 | **GATEH** | **Gate turn on**<br>This pin sources current, $I_{SOURCE}$, to the OR'ing MOSFET Gate. |
| **5** | **$V_{CC}$** | **Power Supply**<br>This is the supply pin. It is recommended to decouple this point to ground closely with a ceramic capacitor. |
| **6** | **GND** | **Ground**<br>This is the ground reference point. Connect to the OR'ing MOSFET Source terminal. |
| **7** | **BIAS** | **Bias**<br>This pin is connected to $V_{CC}$ via resistor, $R_{BIAS}$. $R_{BIAS}$ should be selected to source 1.2 times $I_{REF}$ into this pin. See Note 1 |
| 8 | **DRAIN** | **Drain connection**<br>This pin connects directly to the OR'ing MOSFET Drain terminal. |

Note 1- **BIAS** and **REF** pins should be assumed to be at **GND**+0.7V.

## 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. At system start up, the MOSFET body diode is forced to conduct current from the input power supply to the load and there is approximately -0.6V on the Drain pin.

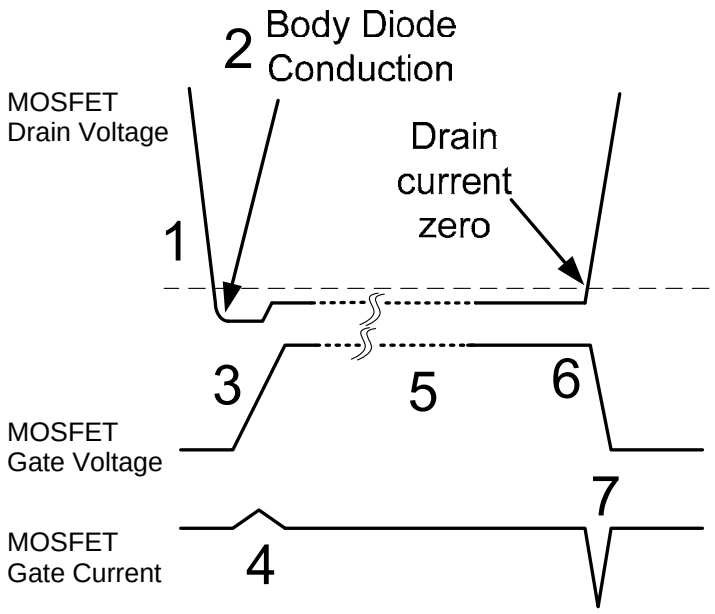
3. The detector outputs a positive voltage with respect to ground, this voltage is then fed to the MOSFET driver stage and current is sourced out of the GATEH pin. The turn on time of the MOSFET can be programmed through an external resistor RG. Refer to “Speed vs. Gate resistance” graph.

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

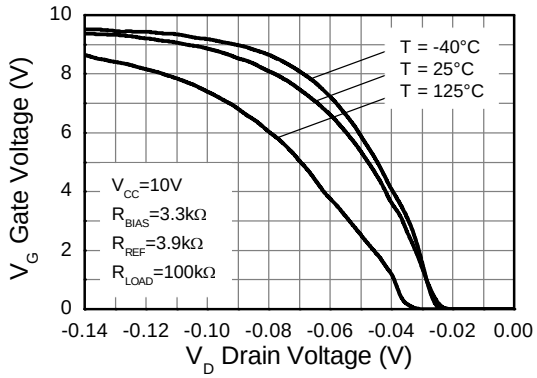
5. The GATEH output voltage is proportional to the Drain-Source voltage drop across the MOSFET due to the load current flowing through the MOSFET. The controller increases its output gate voltage when the Drain current is high to ensure full MOSFET enhancement

6. If a short condition occurs on the input power supply it causes the OR’ing MOSFET Drain current to fall very quickly.

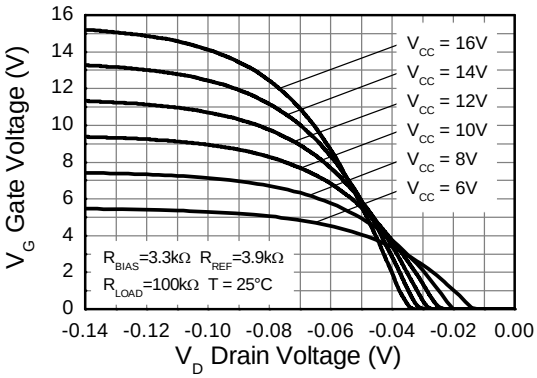
7. When the Drain-Source differential voltage drops below the turn off threshold, the MOSFET Gate voltage is pulled low by GATEL, turning the device off. This prevents high reverse current flow from the load to the input power supply which could pull down the common bus voltage causing catastrophic system failure



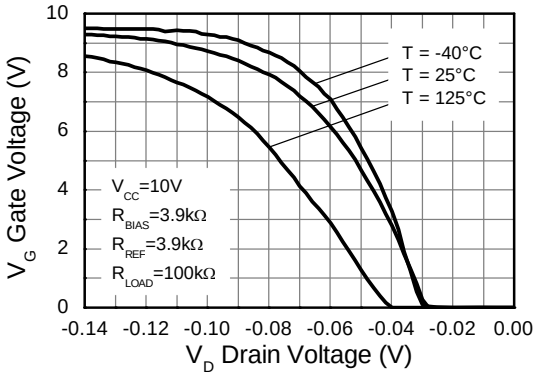
## Typical characteristics




**Transfer Characteristic**




**Transfer Characteristic**

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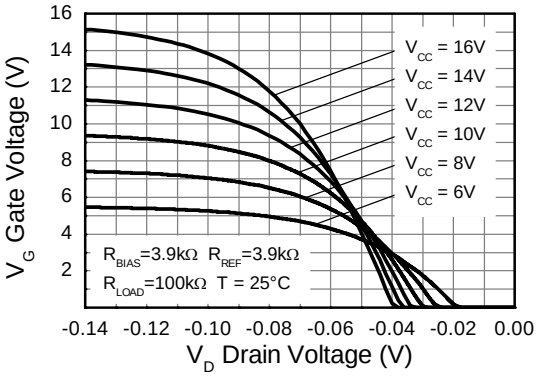
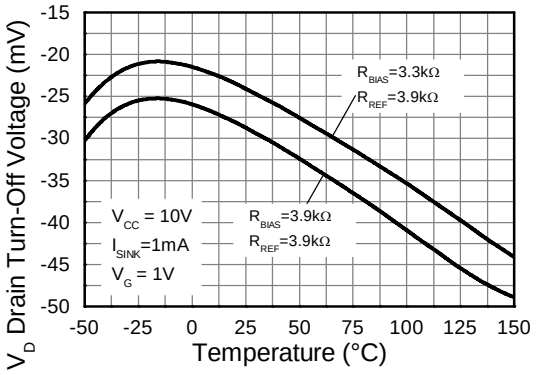
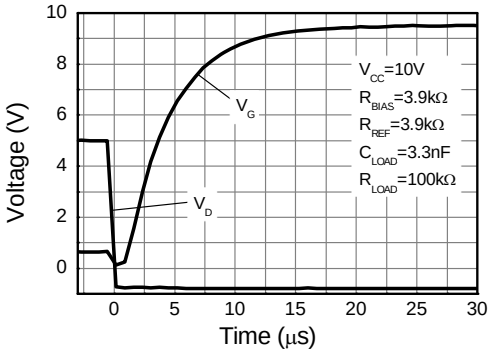



**Transfer Characteristic**

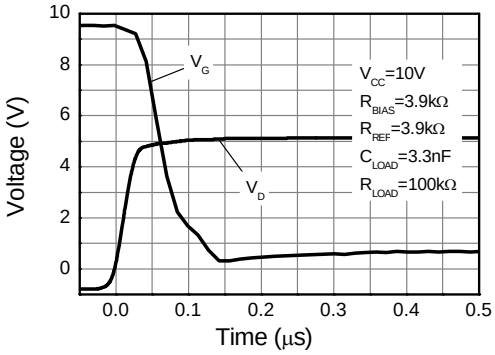



**Turn-Off Voltage vs Temperature**

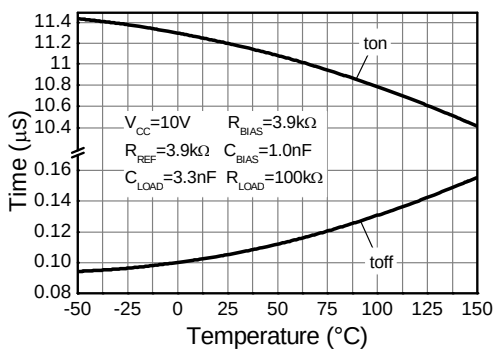
## Typical characteristics



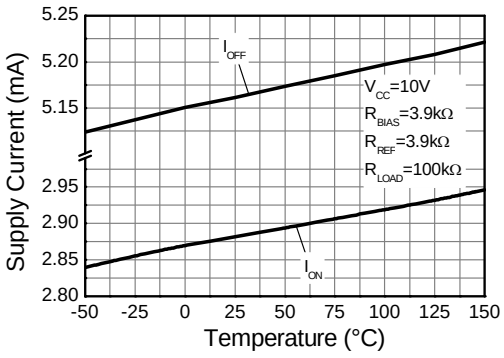

**Switch-On Speed**




**Switch-Off Speed**

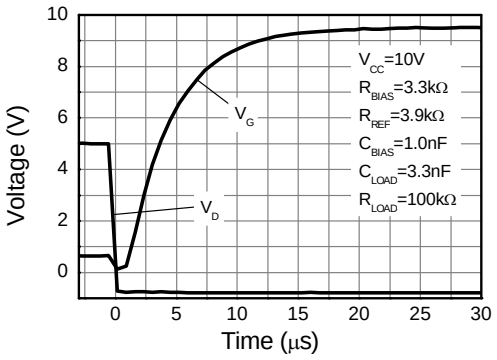



**Speed vs Temperature**

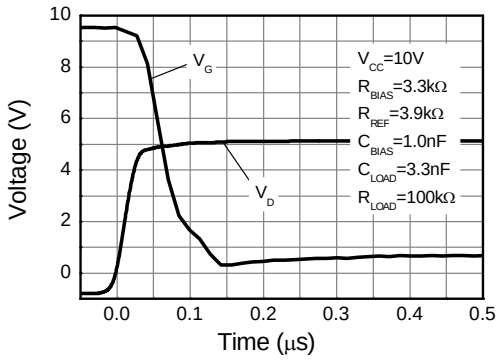



**Supply Current vs Temperature**

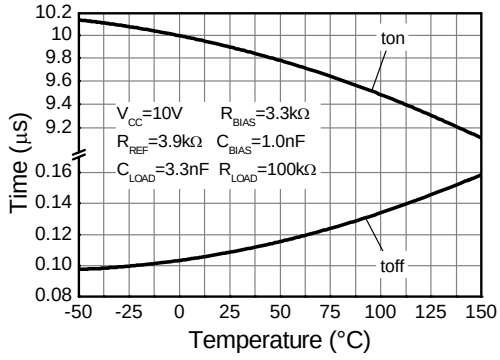
## Typical characteristics



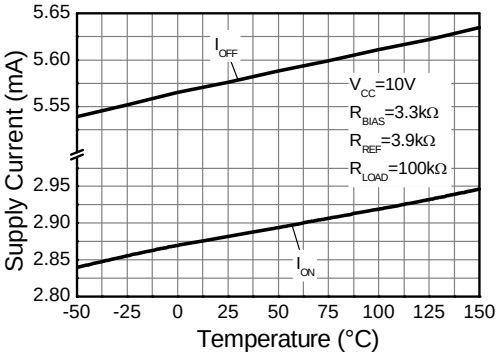

**Switch-On Speed**




**Switch-Off Speed**




**Speed vs Temperature**




**Supply Current vs Temperature**

## Component Selection

It is advisable to decouple the ZXGD3102 closely to $V_{CC}$ and ground due to the possibility of high peak gate currents, as indicated by C1 in Figure 4. In applications where the input voltage is higher than 12V, it is recommended to use a zener diode, ZD1 as shown in the Typical Application Circuit on page 1, and in Figure 2, in order to limit the VCC supply voltage to the ZXGD3102 and also to limit the maximum voltage applied to the gate of the MOSFET. A suitable value for the zener is 10V.

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 ~2.4mA. The value of $R_{BIAS}$ must then be ~1.2 times the value of $R_{REF}$ to give a bias current, $I_{BIAS}$, of 1.2 times $I_{REF}$ .

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.

$R_{REF} = (V_{CC} - 0.7V)/ 0.0024$

$R_{BIAS} = (V_{CC} - 0.7V)/ 0.0028$

The addition of $C_{BIAS}$ controls the switch-on delay of the MOSFET, and ensures stability. A suitable value is 1nF.

## 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. Trace widths should be maximized in the high current path through the MOSFET and ground return in order to minimize the effects of circuit inductance and resistance.

## Active OR'ing or N+1 redundancy

- In normal operation, power supply A and B share the load for maximum reliability.
- Power supply A supports the load if power supply B fails and vice versa.
- Blocking diodes protect the load from a faulty power supply affecting the load voltage.
- The load can be tens of amps.
- Dissipation in the diodes can be high!
- The ZXGD3102 is designed to switch the low on-resistance MOSFETs used to replace the blocking diodes.

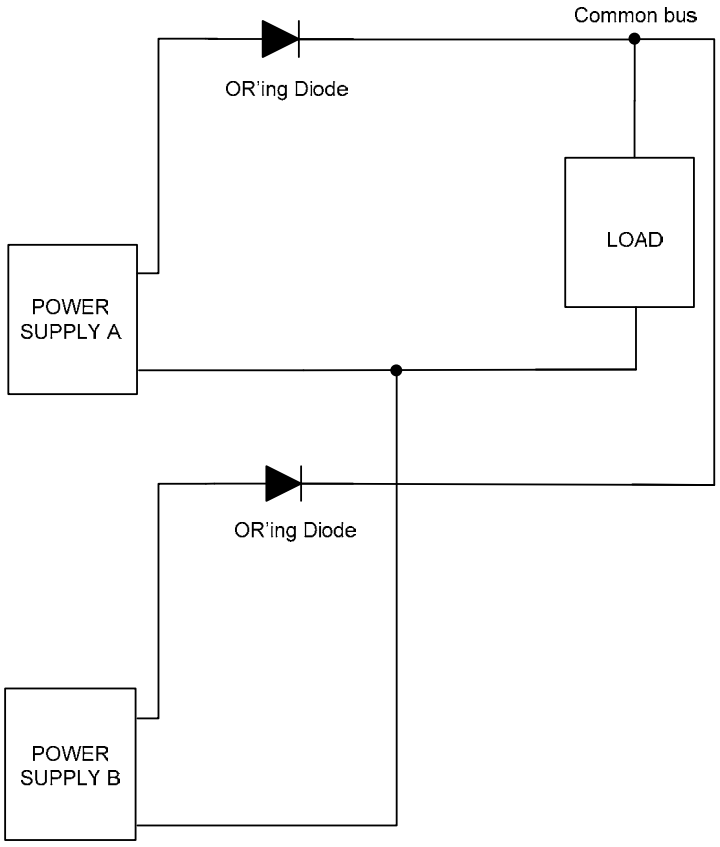



**Figure 1: OR'ING with Schottky Diodes**

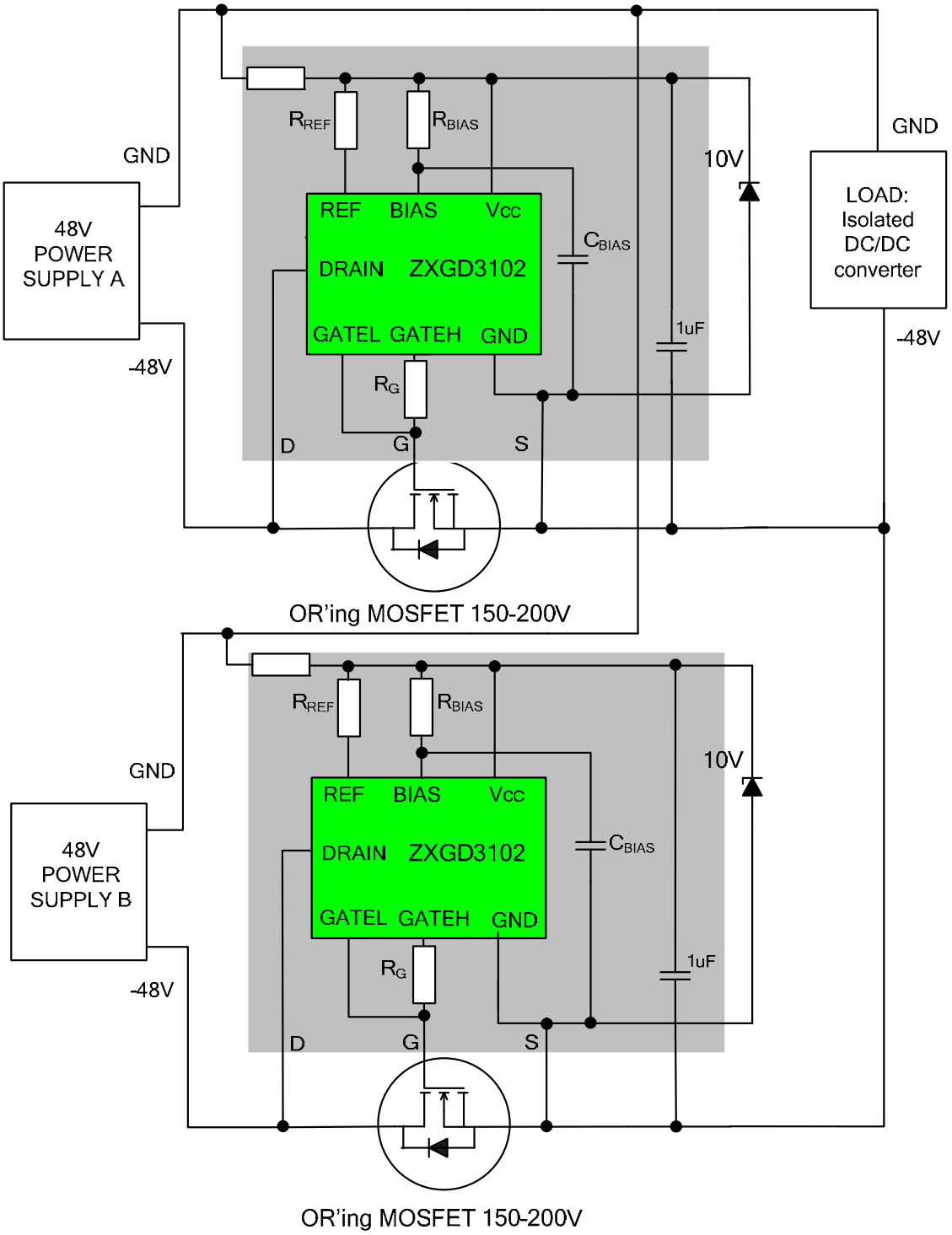



**Figure 2: Negative telecom active OR'ing evaluation**

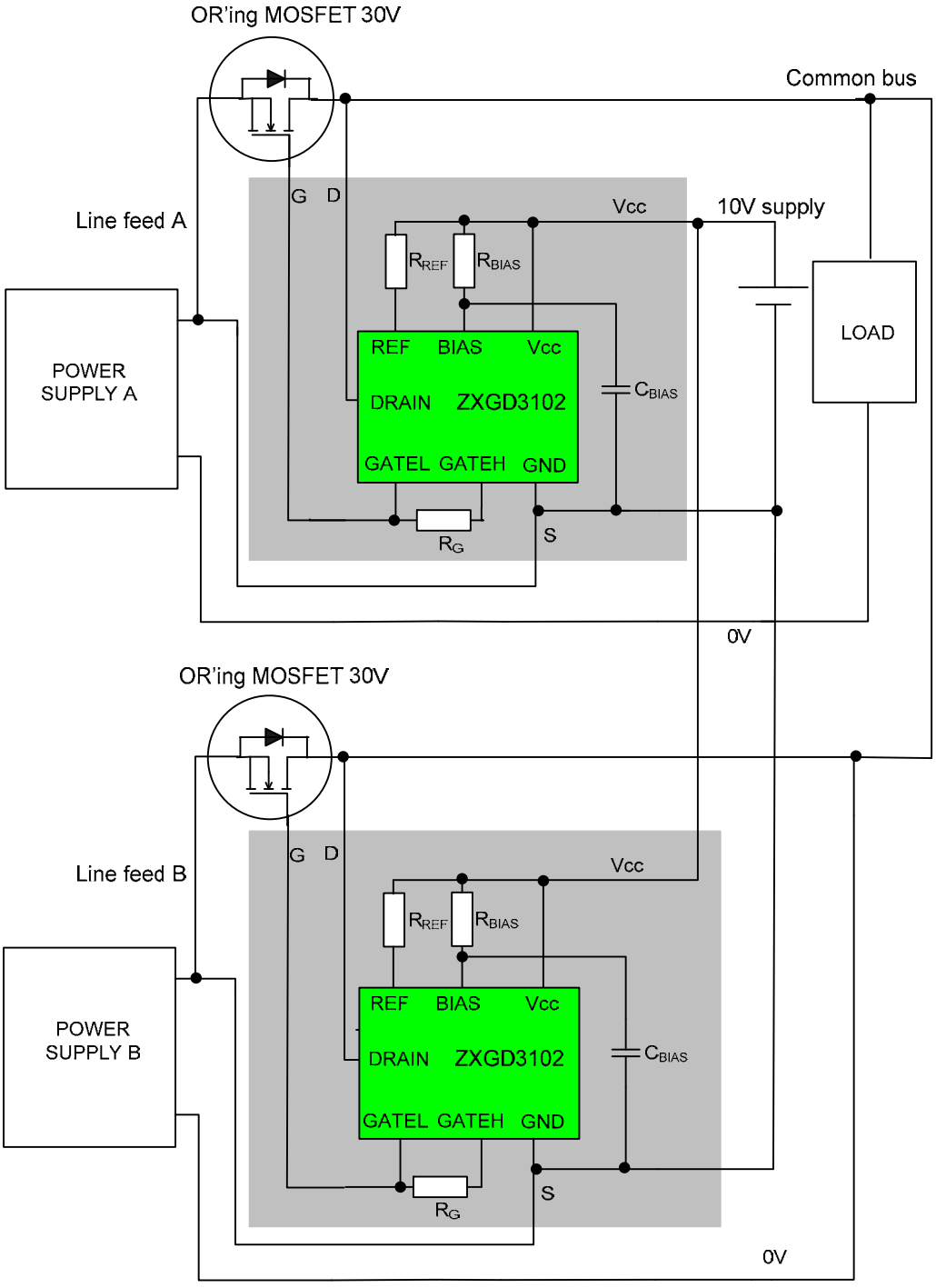



**Figure 3: Positive rail power supply active OR'ing evaluation**

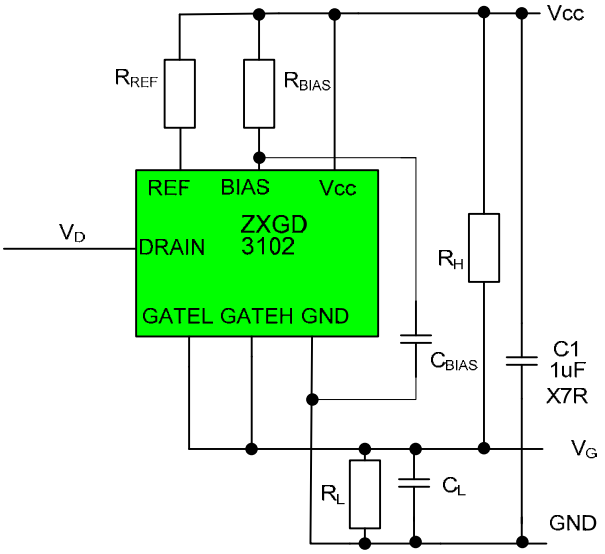



**Figure 4: Test Circuit**

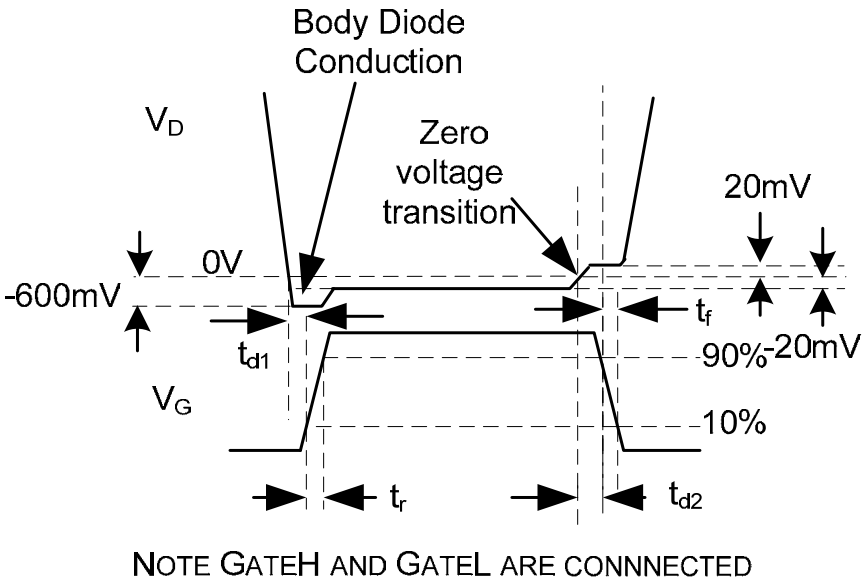
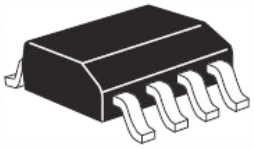


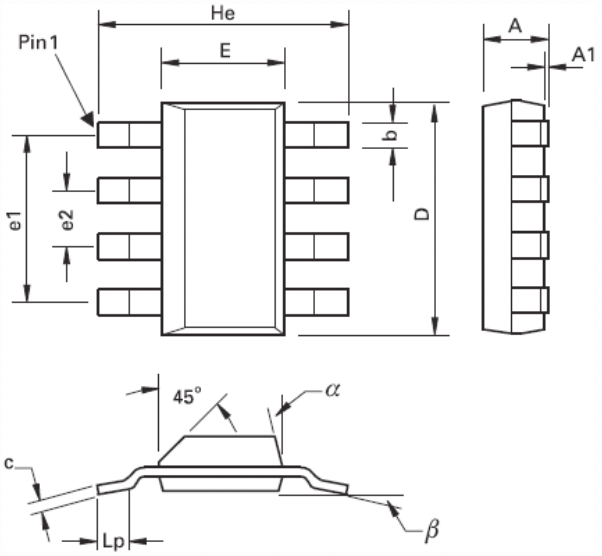

**Figure 5: Timing Diagram**



# Package information - SM8

## Surface mounted, 8 pin package

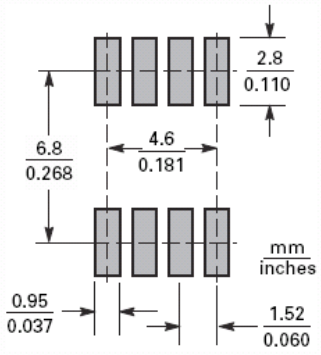
### Package outline




| DIM | Millimeters | | | Inches | | | DIM | Millimeters | | | Inches | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Min. | Max. | Typ. | Min. | Max. | Typ. | | Min. | Max. | Typ. | Min. | Max. | Typ. |
| A | - | 1.7 | - | - | 0.067 | - | e1 | - | - | 4.59 | - | - | 0.1807 |
| A1 | 0.02 | 0.1 | - | 0.0008 | 0.004 | - | e2 | - | - | 1.53 | - | - | 0.0602 |
| b | - | - | 0.7 | - | - | 0.0275 | He | 6.7 | 7.3 | - | 0.264 | 0.287 | - |
| c | 0.24 | 0.32 | - | 0.009 | 0.013 | - | Lp | 0.9 | - | - | 0.035 | - | - |
| D | 6.3 | 6.7 | - | 0.248 | 0.264 | - | α | - | 15° | - | - | 15° | - |
| E | 3.3 | 3.7 | - | 0.130 | 0.145 | - | β | - | - | 10° | - | - | 10° |

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

### Soldering footprint



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   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 labeling can be reasonably expected to result in significant injury to the user.

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