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.

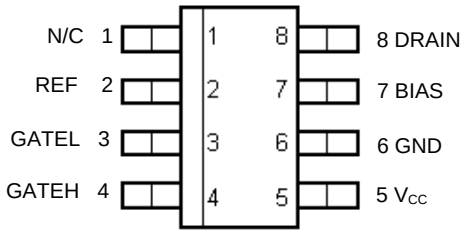
Features

- Turn-off time typically 105ns
- 180V blocking voltage
- Proportional Gate drive
- 2A Source, 5A Sink driver
- V_{CC} Range 5-15V
- Low component count

Applications

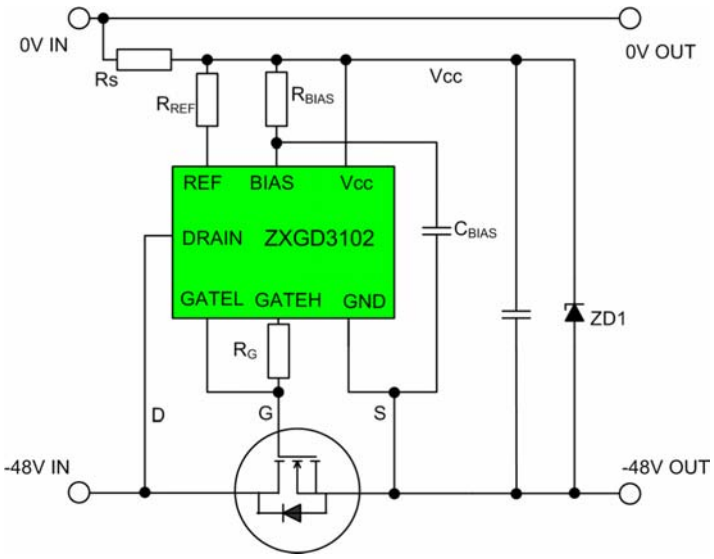
- High Side OR'ing diode replacement for Servers, Computer
- Low Side OR'ing diode replacement for Telecoms
- Ideal diode applications

Pin out details



SM8

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

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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

(†) 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

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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_D ≤ -100m V	-	2.4	-	mA
		V_D ≥ 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_D ≥ 0V, (*)	-	0.58	1	V
	V_G	V_D = -60mV, (†)	4.1	7	-	
		V_D = -80mV, (†)	6.5	8.5	-	
		V_D = -100mV, (†)	8.0	9	-	
		V_D = -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_D ≤ -100m V (†)	-	2.4	-	mA
		V_D ≥ 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_D ≥ 0V, (*)	-	0.57	1	V
	V_G	V_D = -60mV, (†)	3.5	6.5	-	
		V_D = -80mV, (†)	6.5	8.5	-	
		V_D = -100mV, (†)	8.0	8.8	-	
		V_D = -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_H needed only for characterization purposes, not in the application

(†) R_L = 100kΩ, R_H = O/C; R_L needed only for characterization purposes, not in the application

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

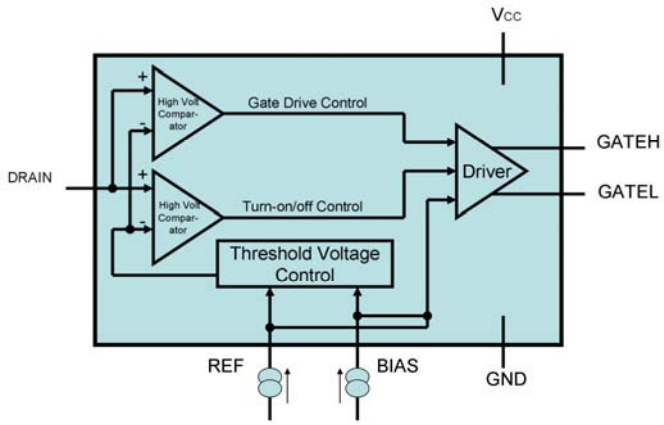
Turn on Propagation delay	t_{d1}	C_L = 3.3nF, C_{BIAS} = 1nF, (†)(a)		1880		ns
Turn off Propagation delay	t_{d2}			30		ns
Gate rise time	t_r			9520		ns
Gate fall time	t_f			75		ns

V_{CC} = 10V; R_{BIAS} = 3.9kΩ ; R_{REF} = 3.9kΩ

Turn on Propagation delay	t_{d1}	C_L = 10nF, C_{BIAS} = 1nF, (†)(a)		1940		ns
Turn off Propagation delay	t_{d2}			32		ns
Gate rise time	t_r			9840		ns
Gate fall time	t_f			78		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** 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 2.4mA into this pin. See Note 1
3	**GATEL**	**Gate turn off** This pin sinks current, I_{SINK}, from the OR'ing MOSFET Gate
4	**GATEH**	**Gate turn on** This pin sources current, I_{SOURCE}, to the OR'ing MOSFET Gate
5	**V_{CC}**	**Power Supply** This is the supply pin. Decouple this point to ground with a ceramic capacitor
6	**GND**	**Ground** This is the ground reference point. Connect to the OR'ing MOSFET Source terminal
7	**BIAS**	**Bias** This pin is connected to V_{CC} via R_{BIAS}. R_{BIAS} should be selected to source either 1 or 1.2 times I_{REF} into this pin depending on the desired turn-off threshold voltage, V_T. See Note 1
8	**DRAIN**	**Drain connection** 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.

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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.

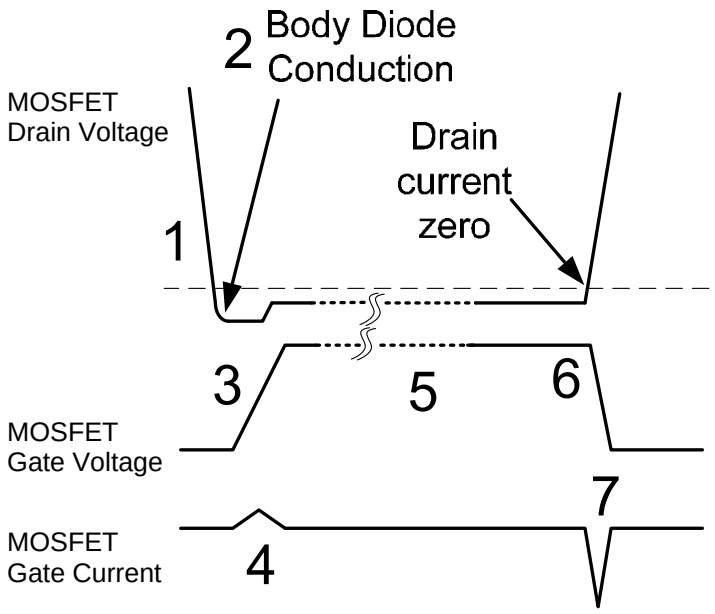
3. The detector outputs a positive voltage with respect to ground, this voltage is then fed to the MOSFET driver stage and current is sourced out of the GATEH pin. The turn on time of the MOSFET can be programmed through an external resistor RG. Refer to “Speed vs. Gate resistance” graph.

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

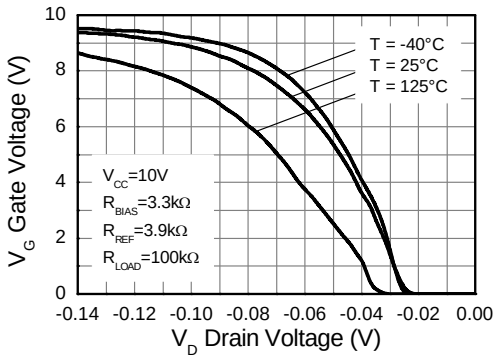
6. If a short condition occurs on the input power supply it causes the OR’ing MOSFET Drain current to fall very quickly.

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

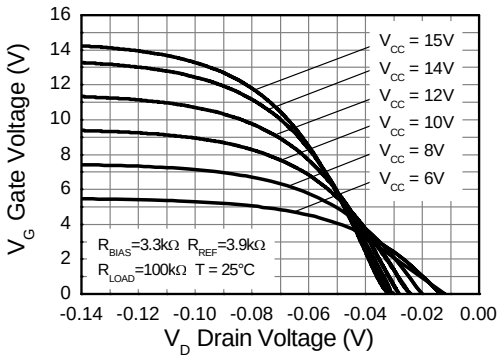


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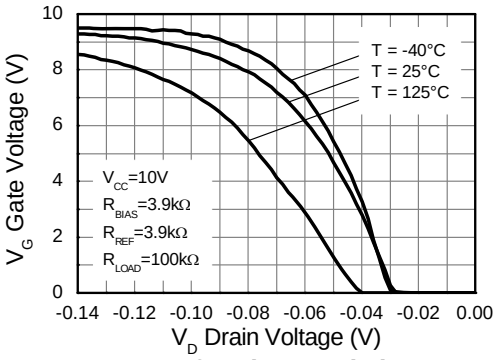
Typical characteristics



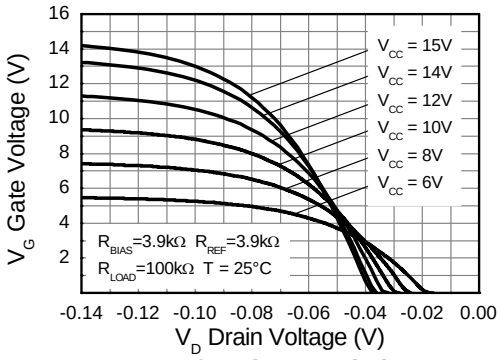
Transfer Characteristic



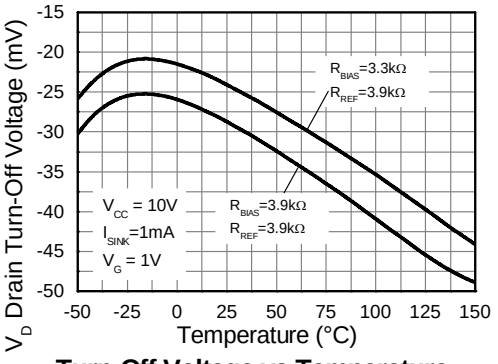
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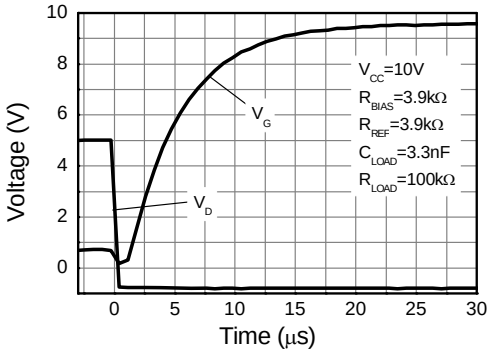
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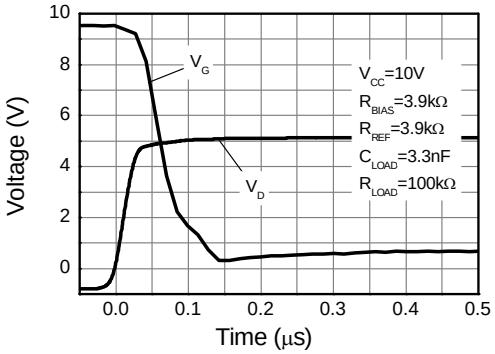
Turn-Off Voltage vs Temperature

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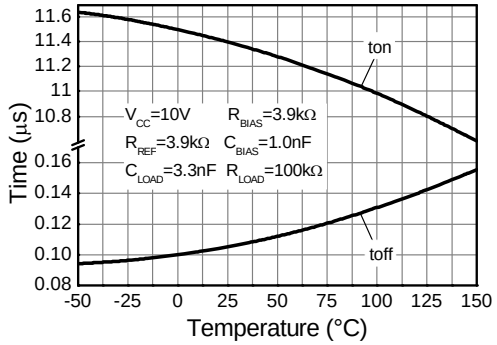
Typical characteristics



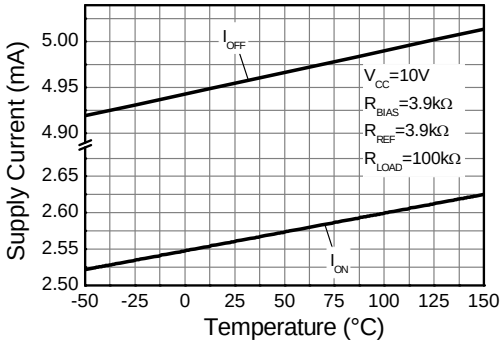
Switch-On Speed



Switch-Off Speed



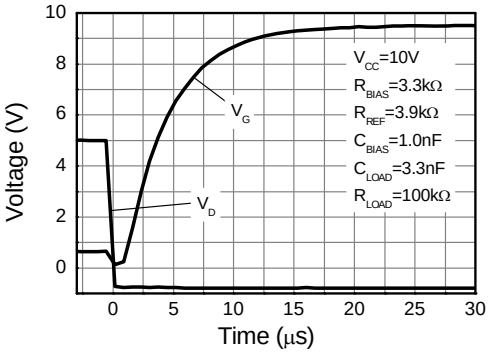
Speed vs Temperature



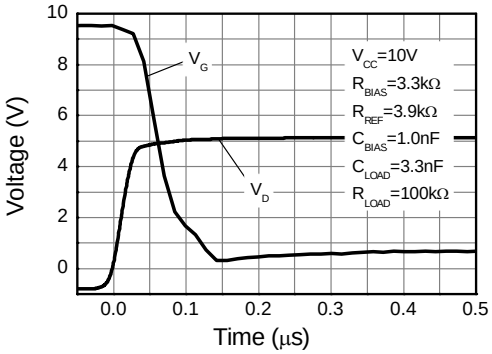
Supply Current vs Temperature

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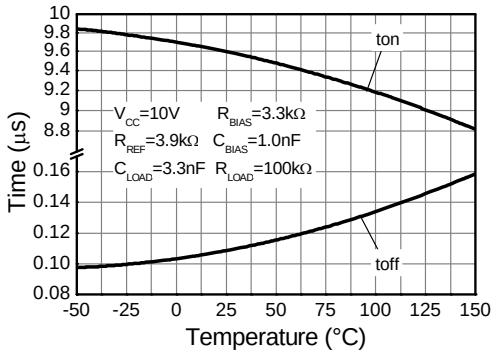
Typical characteristics



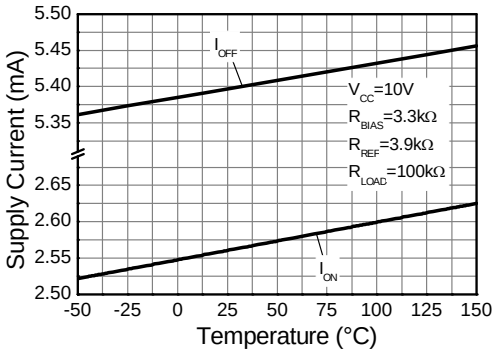
Switch-On Speed



Switch-Off Speed



Speed vs Temperature



Supply Current vs Temperature

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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 V_{CC} 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 selected to give a bias current, I_{BIAS}, of approximately 1.2 times I_{REF}. This set the turn-off threshold voltage V_T of the controller to '-24mV' at V_{CC} =10V.

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

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

Alternatively, R_{REF} and R_{BIAS} can be chosen to be equal to set the turn-off threshold voltage V_T to '-29mV' at V_{CC} =10V. This also reduces the IC current consumption when the gate voltage is off.

External gate resistor to GATEH pin is optional. It can be inserted to control the turn-on gate rise time which may help with in-rush current protection, EMI issues or power dissipation within the part. 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.

For best thermal performance, the PCB heat path from pins 5 and 6 needs attention. The area of copper connected to pins 5 and 6 should be maximised.

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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.

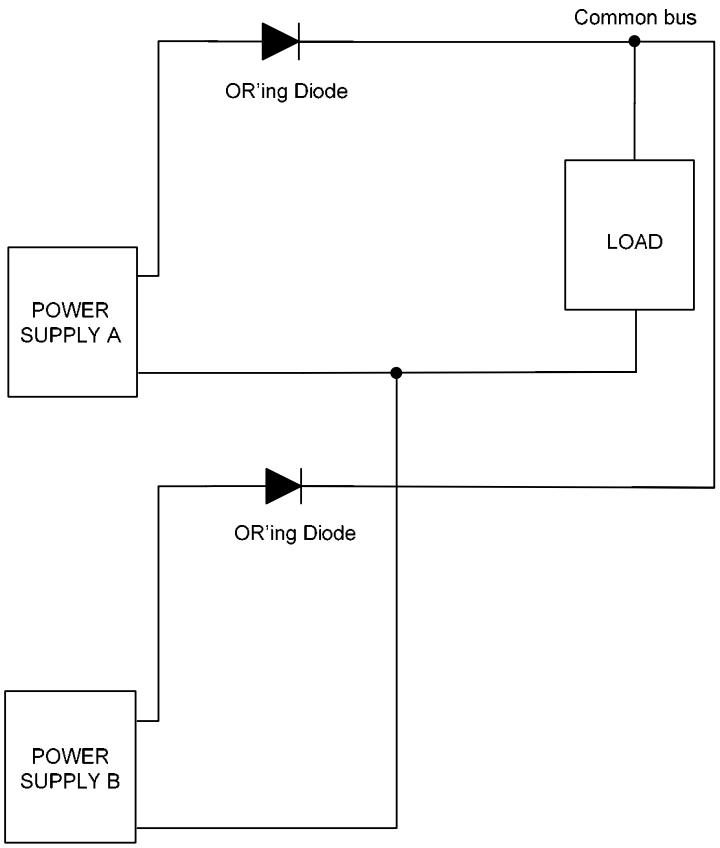


Figure 1: OR'ING with Schottky Diodes

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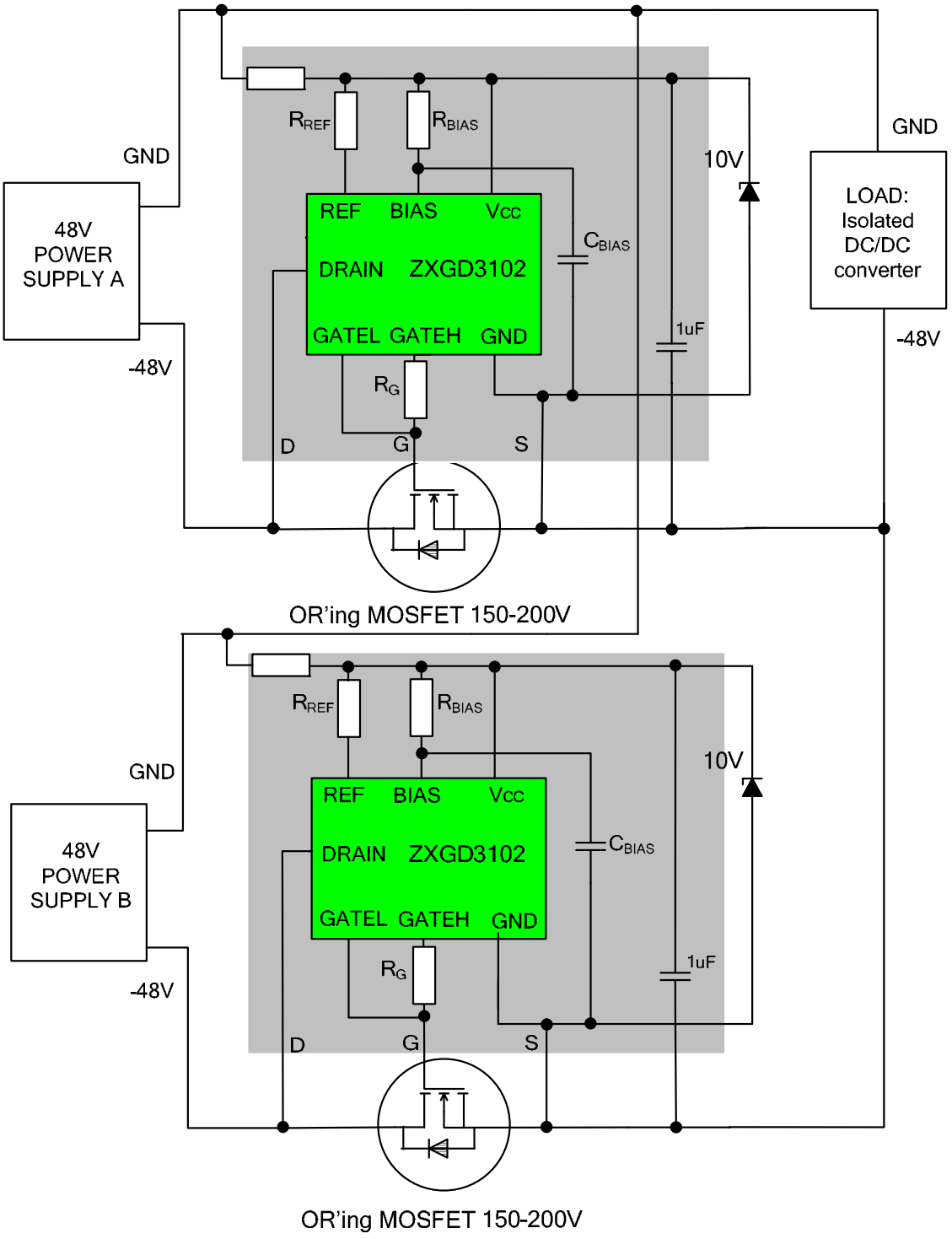


Figure 2: Negative telecom active OR'ing evaluation

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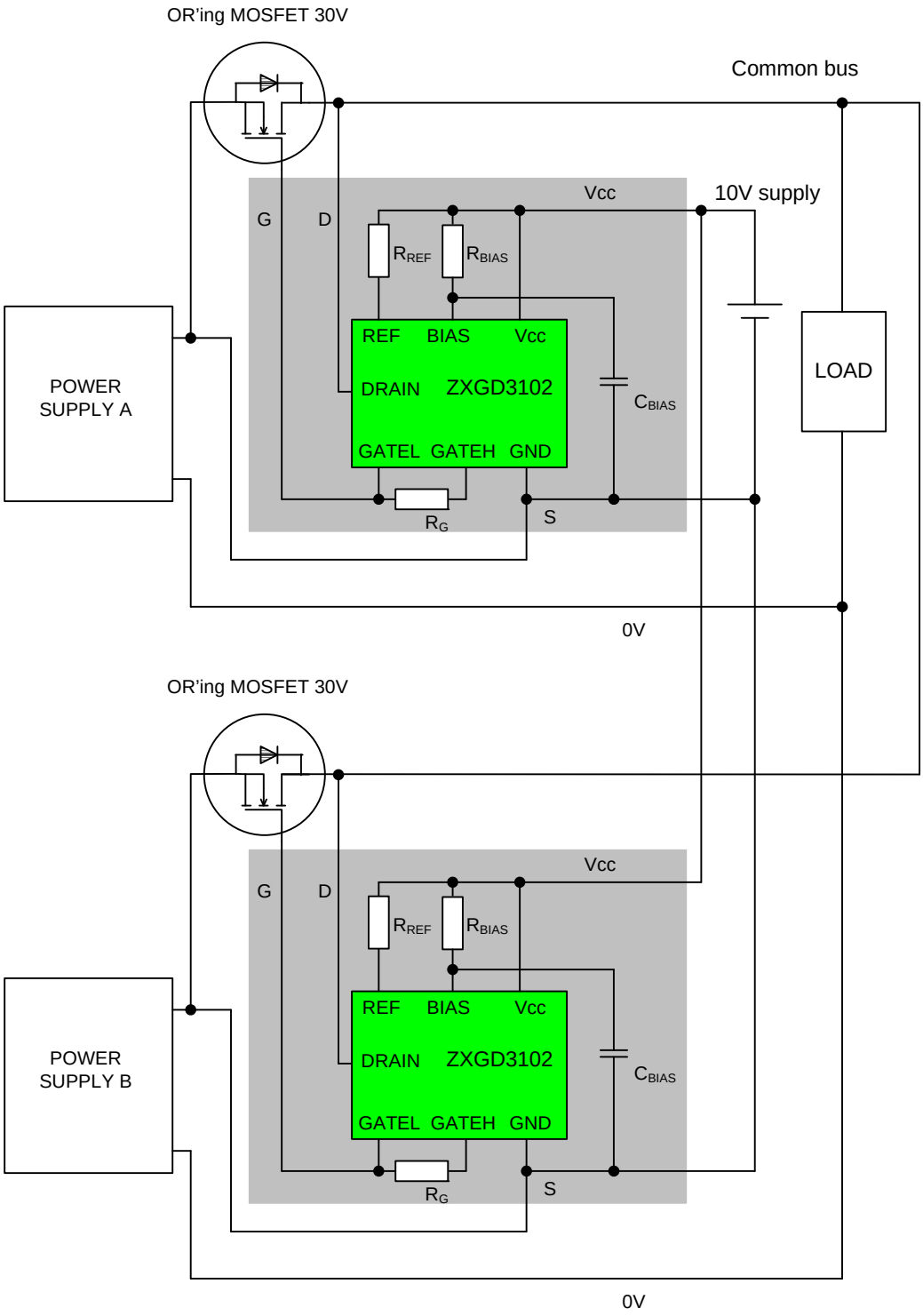


Figure 3: Positive rail power supply active OR'ing evaluation

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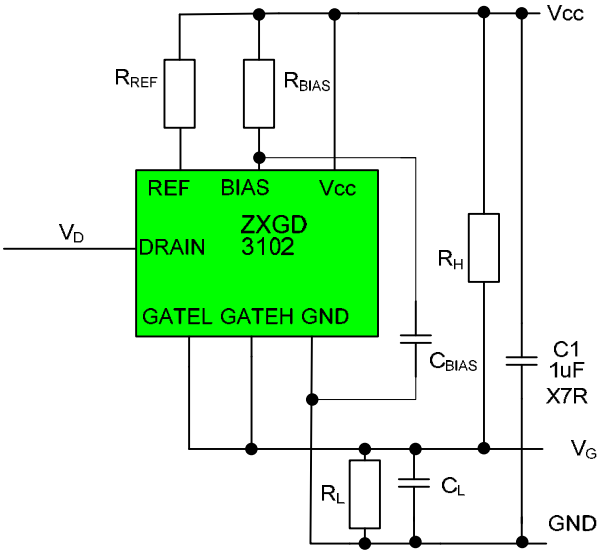


Figure 4: Test Circuit

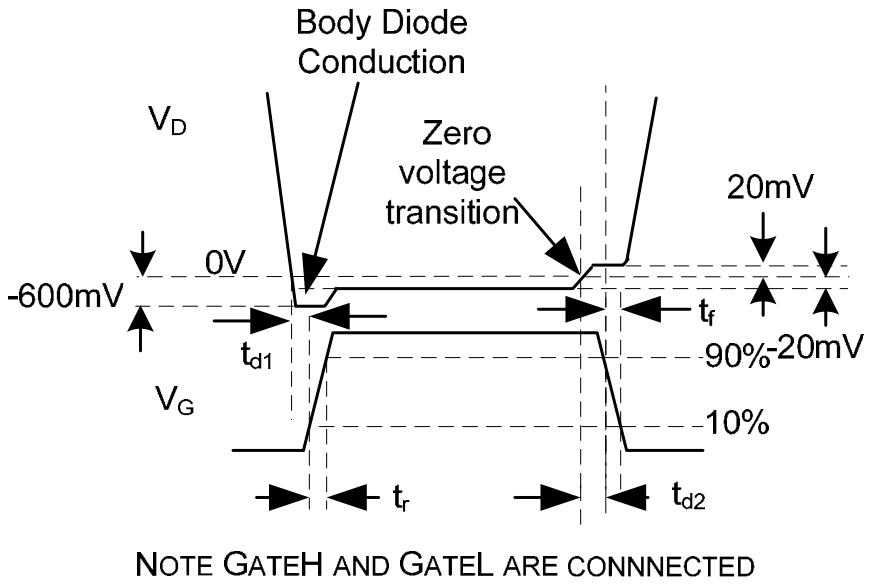
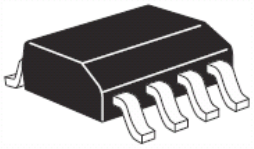


Figure 5: Timing Diagram

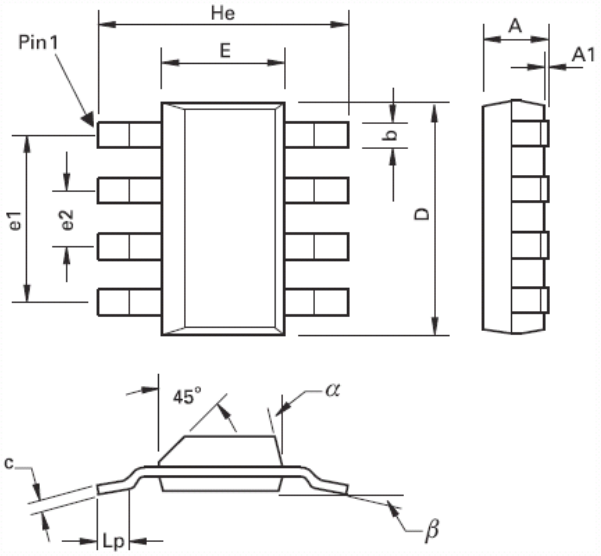
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Package information - SM8

Surface mounted, 8 pin package

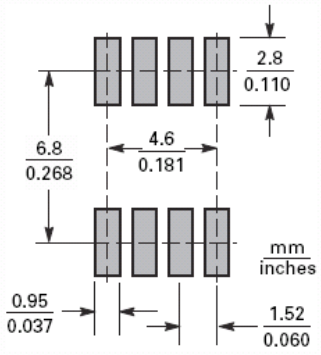
Package outline



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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