# 40V 10A GATE DRIVER IN SOT26

## Description

ZXGD3006E6 is a 40V Gate Driver for switching IGBTs and SiC MOSFETs. It can transfer up to 10A peak source/sink current into the gate for effective charging and discharging of a large capacitive load.

The ZXGD3006E6 can drive typically 4A into the low gate impedance of an IGBT, with just 1mA input from a controller. Also, the turn-on and turn-off switching behavior of the IGBT can be individually tailored to suit an application. In particular, by defining the switching characteristics appropriately, EMI and cross conduction problems can be reduced.

## Applications

Gate driving IGBTs and SiC MOSFETs in:

- DC-DC Converters in Electric Cars
- Automotive Active Suspension Systems
- Solar Inverters
- Power Supplies
- Plasma Display Panel Power Modules

## Features

- High-gain buffer with typically 4A output from 1mA input
- 40V supply for +20V to -18V gate driving to prevent dV/dt induced false triggering
- Emitter-follower that is rugged to latch-up / shoot-through issues, and delivers <10ns propagation delay time
- Separate source and sink outputs for independent control of IGBT turn-on and turn-off times
- Optimized pin-out to simplify PCB layout and reduce parasitic trace inductances
- Near-zero quiescent supply current
- **Totally Lead-Free & Fully RoHS compliant (Notes 1 & 2)**
- **Halogen and Antimony free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**
- **PPAP capable (Note 4)**

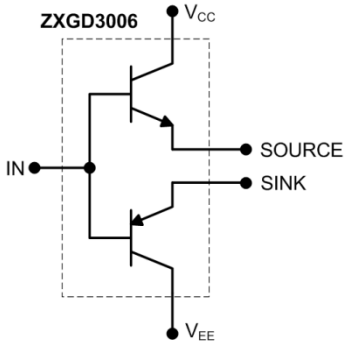
## Mechanical Data

- Case: SOT26
- Case material: molded plastic. "Green" molding compound.
- UL Flammability Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish - Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.018 grams (approximate)

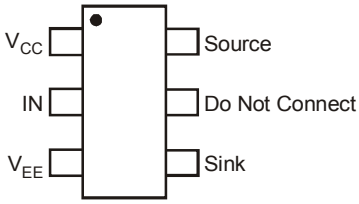
SOT26



Top View




Internal Device Schematic




Top View
Pin-Out

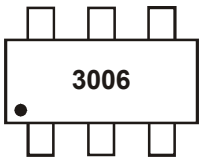
| Pin Name | Pin Function |
|---|---|
| $V_{CC}$ | Supply Voltage High |
| IN | Driver Input Pin |
| $V_{EE}$ | Supply Voltage Low |
| SOURCE | Source Current Output |
| SINK | Sink Current Output |

## Ordering Information (Notes 4 & 5)

| Product | Compliance | Marking | Reel size (inches) | Tape width (mm) | Quantity per reel |
|---|---|---|---|---|---|
| ZXGD3006E6TA | AEC-Q101 | 3006 | 7 | 8 | 3,000 |
| ZXGD3006E6QTA | Automotive | 3006 | 7 | 8 | 3,000 |

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. Automotive products are AEC-Q101 qualified and are PPAP capable. Automotive, AEC-Q101 and standard products are electrically and thermally the same, except where specified.
5. For packaging details, go to our website at http://www.diodes.com/products/packages.html.

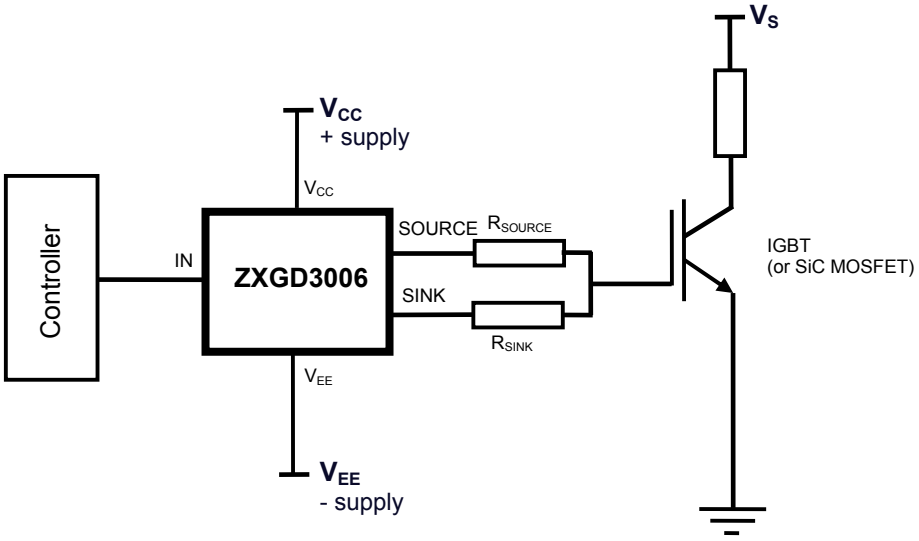
## Marking Information




3006 = Product Type Marking Code


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## Typical Application Circuit




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

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Supply voltage, with respect to $V_{EE}$ | $V_{CC}$ | 40 | V |
| Input voltage, with respect to $V_{EE}$ | $V_{IN}$ | 40 | V |
| Output difference voltage (Source – Sink) | $\Delta V_{(source-sink)}$ | ±7.5 | V |
| Peak output current | $I_{PK}$ | ±10 | A |
| Input current | $I_{IN}$ | ±100 | mA |

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

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Power Dissipation (Notes 6 & 7)<br>Linear derating factor | $P_D$ | 1.1<br>8.8 | W<br>mW/°C |
| Thermal Resistance, Junction to Ambient (Notes 6 & 7) | $R_{\theta JA}$ | 113 | °C/W |
| Thermal Resistance, Junction to Lead (Note 8) | $R_{\theta JL}$ | 105 | |
| Operating and Storage Temperature Range | $T_J$, $T_{STG}$ | -55 to +150 | °C |

## ESD Ratings (Note 9)

| Characteristic | Symbol | Value | Unit | JEDEC Class |
|---|---|---|---|---|
| Electrostatic Discharge - Human Body Model | ESD HBM | ≥ 1,500 | V | 1C |
| Electrostatic Discharge – Charged Device Model | ESD CDM | ≥ 1,000 | V | IV |

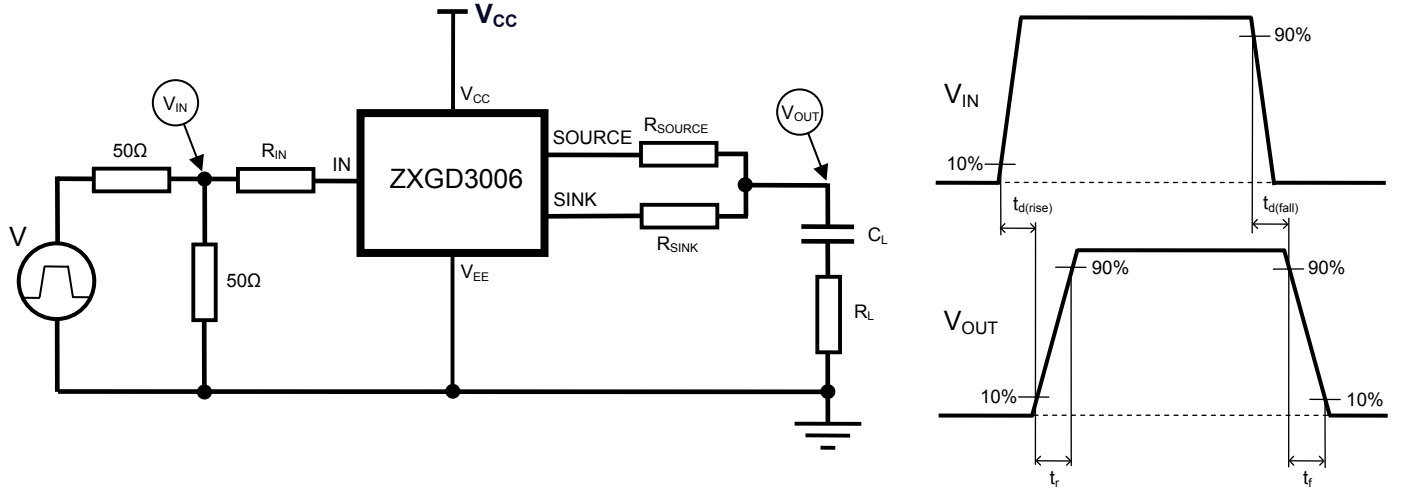
Notes:
6. For a device mounted on 25mm x 25mm 1oz copper that is on a single-sided 1.6mm FR4 PCB; device is measured under still air conditions whilst operating in a steady-state. The heatsink is split in half with the pin 1 ($V_{CC}$) and pin 3 ($V_{EE}$) connected separately to each half.
7. For device with two active die running at equal power.
8. Thermal resistance from junction to solder-point at the end of each lead on pin 1 ($V_{CC}$) and pin 3 ($V_{EE}$).
9. Refer to JEDEC specification JESD22-A114 and JESD22-C101.


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

| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition | |
|---|---|---|---|---|---|---|---|
| Output voltage, high | $V_{OUT(hi)}$ | $V_{CC}$ - 1.0 | $V_{CC}$ - 0.8 | — | V | $V_{IN}$ = $V_{CC}$ | $C_L$ = 1nF |
| Output voltage, low | $V_{OUT(low)}$ | — | $V_{EE}$ + 0.12 | $V_{EE}$ + 0.3 | | $V_{IN}$ = $V_{EE}$ | $R_{SOURCE}$ = 0Ω, $R_{SINK}$ = 0Ω |
| Supply breakdown voltage | $BV_{CC}$ | 40 | — | — | V | $I_Q$ = 100μA, $V_{IN}$ = $V_{CC}$ | |
| | | 40 | — | — | | $I_Q$ = 100μA, $V_{IN}$ = $V_{EE}$ = 0V | |
| Quiescent supply current | $I_Q$ | — | — | 50 | nA | $V_{CC}$ = 30V, $V_{IN}$ = $V_{CC}$ | |
| | | — | — | 50 | | $V_{CC}$= 30V, $V_{IN}$ = $V_{EE}$ = 0V | |
| Source current | $I_{(source)}$ | — | 4.0 | — | A | $V_{CC}$= 5V, $I_{IN}$= 1mA, $V_{OUT}$= 0V | |
| Sink current | $I_{(sink)}$ | — | 3.8 | — | | $V_{CC}$= 5V, $I_{IN}$=-1mA, $V_{OUT}$= 5V | |
| Source current<br>with varying input resistances | $I_{(source)}$ | — | 6.4<br>5.5<br>3.9<br>2.2<br>0.44 | — | A | $R_{IN}$ = 200Ω<br>$R_{IN}$ = 1kΩ<br>$R_{IN}$ = 10kΩ<br>$R_{IN}$ = 100kΩ<br>$R_{IN}$ = 1000kΩ | $V_{CC}$ = 15V, $V_{EE}$ = 0V<br>$V_{IN}$ = 15V<br>$C_L$ = 100nF, $R_L$ = 0.18Ω<br>$R_{SOURCE}$ = 0Ω, $R_{SINK}$ = 0Ω |
| Sink current<br>with varying input resistances | $I_{(sink)}$ | — | 7.7<br>6.5<br>4.4<br>2.3<br>0.46 | — | A | $R_{IN}$ = 200Ω<br>$R_{IN}$ = 1kΩ<br>$R_{IN}$ = 10kΩ<br>$R_{IN}$ = 100kΩ<br>$R_{IN}$ = 1000kΩ | $V_{CC}$ = 15V, $V_{EE}$ = 0V<br>$V_{IN}$ = 15V<br>$C_L$ = 100nF, $R_L$ = 0.18Ω<br>$R_{SOURCE}$ = 0Ω, $R_{SINK}$ = 0Ω |
| Switching times<br>with low load capacitance $C_L$ = 10nF | $t_{d(rise)}$<br>$t_r$<br>$t_{d(fall)}$<br>$t_f$ | — | 8<br>48<br>16<br>35 | — | ns | $V_{CC}$ = 15V, $V_{EE}$ = 0V<br>$V_{IN}$ = 0 to 15V<br>$R_{IN}$ = 1kΩ<br>$C_L$ = 10nF, $R_L$ = 0.18Ω<br>$R_{SOURCE}$ = 0 Ω, $R_{SINK}$ = 0 Ω | |
| Switching times<br>with high load capacitance $C_L$ = 100nF | $t_{d(rise)}$<br>$t_r$<br>$t_{d(fall)}$<br>$t_f$ | — | 46<br>419<br>47<br>467 | — | ns | $V_{CC}$ = 15V, $V_{EE}$ = 0V<br>$V_{IN}$ = 0 to15V<br>$R_{IN}$ = 1kΩ<br>$C_L$ = 100nF, $R_L$ = 0.18Ω<br>$R_{SOURCE}$ = 0Ω, $R_{SINK}$ = 0Ω | |
| Switching times<br>with asymmetric source and sink resistors | $t_{d(rise)}$<br>$t_r$<br>$t_{d(fall)}$<br>$t_f$ | — | 27<br>208<br>11<br>53 | — | ns | $V_{CC}$ = 20V, $V_{EE}$ = -18V<br>$V_{IN}$ = -18 to 20V<br>$R_{IN}$= 1kΩ<br>$C_L$ = 10nF, $R_L$ = 0.18Ω<br>$R_{SOURCE}$ = 4.7Ω, $R_{SINK}$ = 0Ω | |

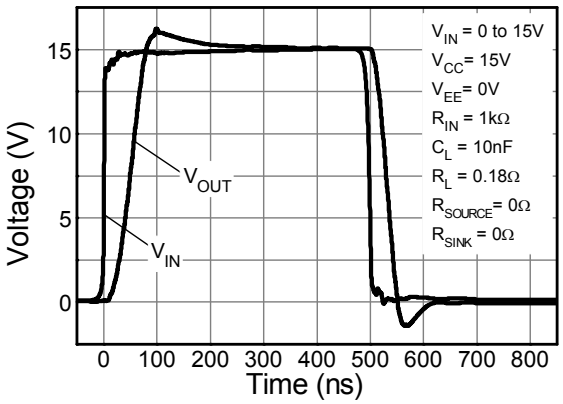
## Switching Test Circuit and Timing Diagram





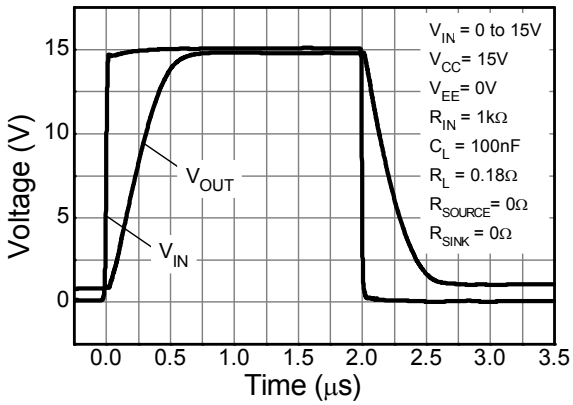
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## Typical Switching Characteristics (@$T_A$ = +25°C, unless otherwise specified.)



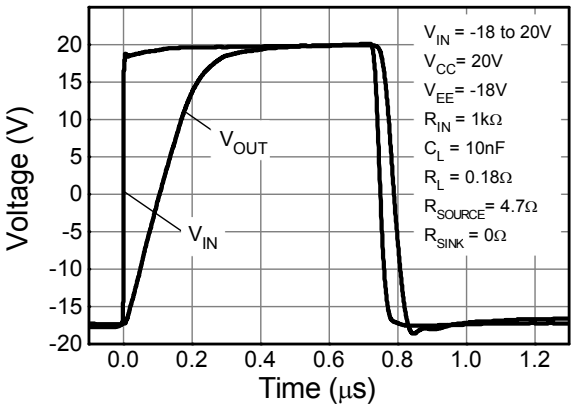

**Switching Speed**

Low Load Capacitance $C_L$ = 10nF



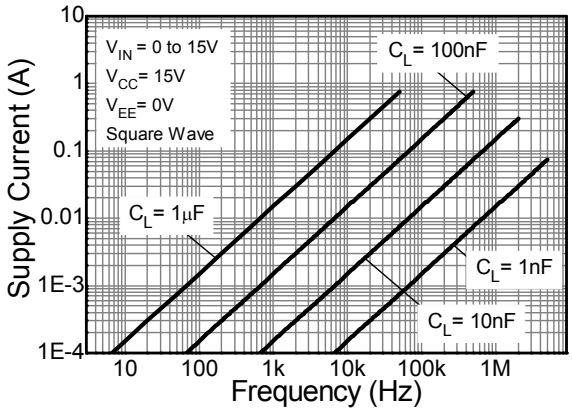

**Switching Speed**

High Load Capacitance $C_L$ = 100nF




**Switching Speed**

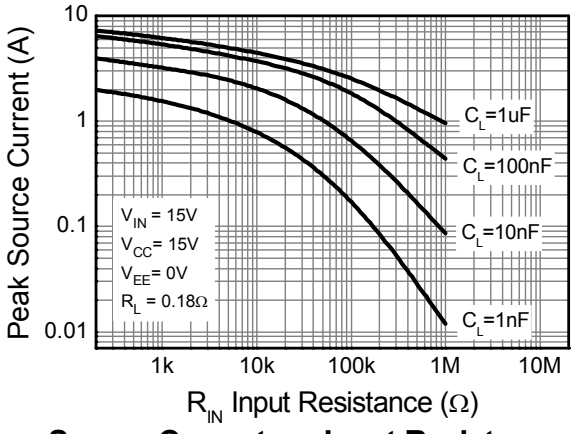
Asymmetric Source and Sink Resistors



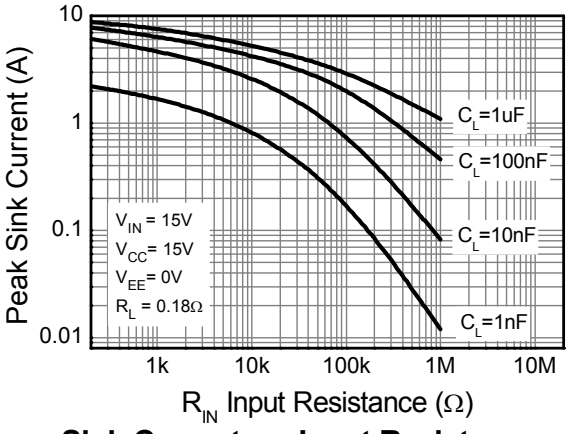

**Supply Current**


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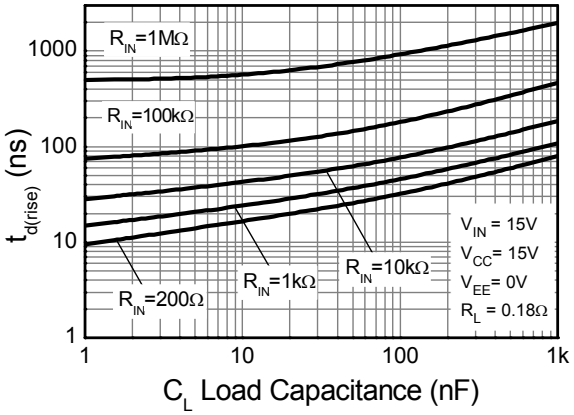
## Typical Switching Characteristics (@$T_A$ = +25°C, unless otherwise specified.)



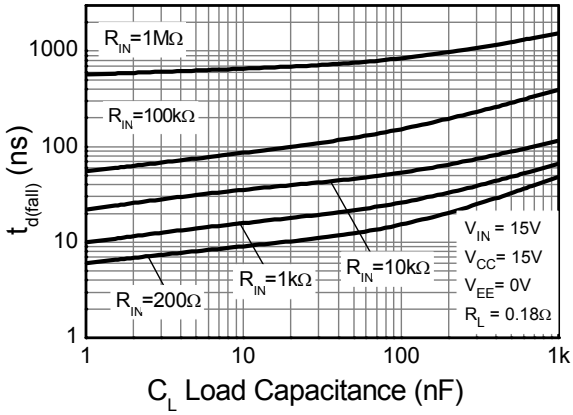

**Source Current vs. Input Resistance**



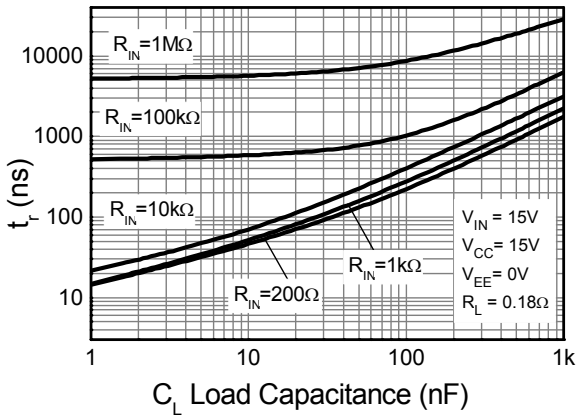

**Sink Current vs. Input Resistance**



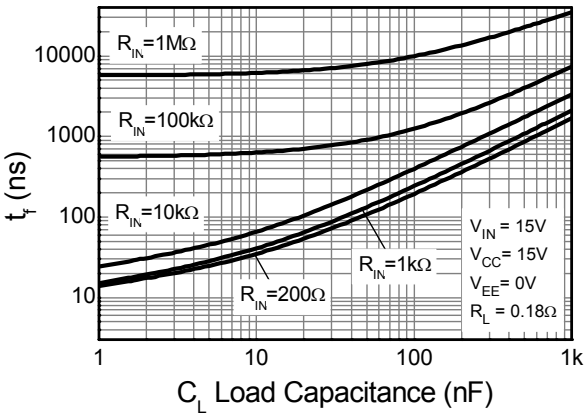

**Turn-On Delay Time**




**Turn-Off Delay Time**




**Turn-On Rise Time**



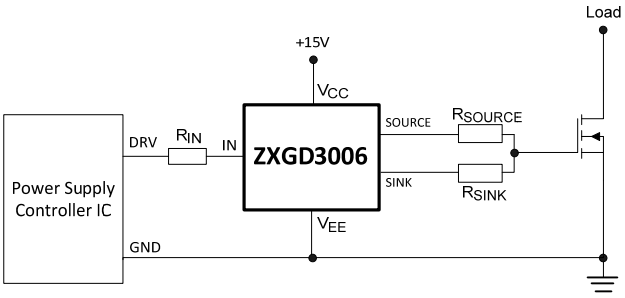

**Turn-Off Fall Time**

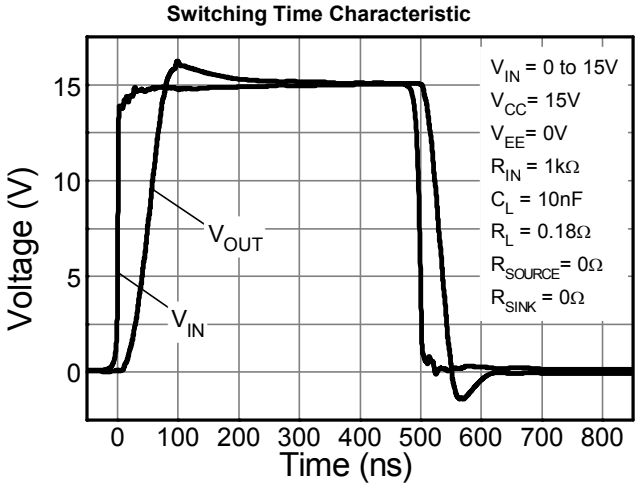

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## Circuit Examples

### ZXGD3006 driving a MOSFET

Application example of the ZXGD3006 driving the gate of a MOSFET from 0 to +15V with $R_{SOURCE}$ = $R_{SINK}$ = 0Ω

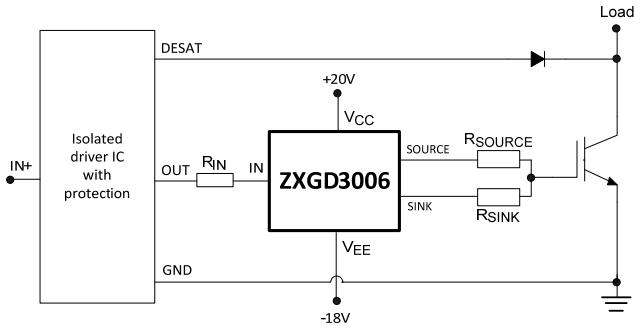


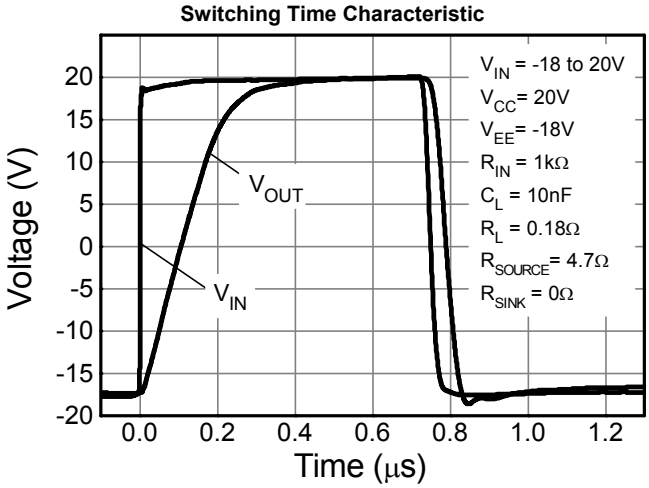




Symmetric Source and Sink Resistors

### ZXGD3006 driving an IGBT

Application example of ZXGD3006 driving the gate of an IGBT with independent $t_{on}$ and $t_{off}$ using asymmetric $R_{SOURCE}$ and $R_{SINK}$ In addition, the gate is driven negative to -18V to prevent dV/dt induced false triggering.



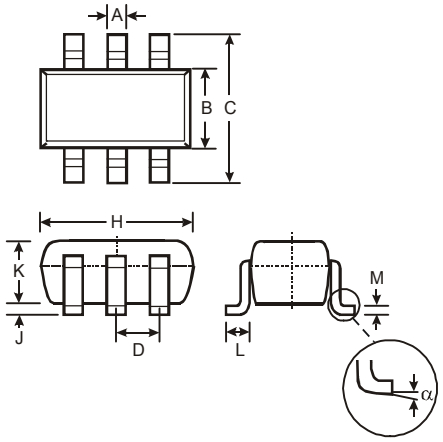




Asymmetric Source and Sink Resistors


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## Package Outline Dimensions

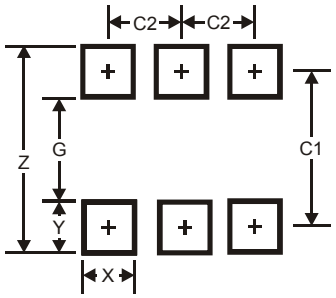
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for latest version.




| SOT26 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 0.35 | 0.50 | 0.38 |
| **B** | 1.50 | 1.70 | 1.60 |
| **C** | 2.70 | 3.00 | 2.80 |
| **D** | — | — | 0.95 |
| **H** | 2.90 | 3.10 | 3.00 |
| **J** | 0.013 | 0.10 | 0.05 |
| **K** | 1.00 | 1.30 | 1.10 |
| **L** | 0.35 | 0.55 | 0.40 |
| **M** | 0.10 | 0.20 | 0.15 |
| **α** | 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) |
|---|---|
| **Z** | 3.20 |
| **G** | 1.60 |
| **X** | 0.55 |
| **Y** | 0.80 |
| **C1** | 2.40 |
| **C2** | 0.95 |


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