# 60V N-CHANNEL ENHANCEMENT MODE MOSFET

## Product Summary

| $BV_{DSS}$ | $R_{DS(on)}$ | $I_D$ $T_A$ = +25°C |
|---|---|---|
| 60V | 0.04Ω @ $V_{GS}$ = 10V | 7.5A |
| | 0.06Ω @ $V_{GS}$ = 4.5V | 6.2A |

## Description

This new generation trench MOSFET features a unique structure combining the benefits of low on-resistance and fast switching, making it ideal for high-efficiency power management applications.

## Applications

- DC-DC converters
- Power management functions
- Disconnect switches
- Motor control

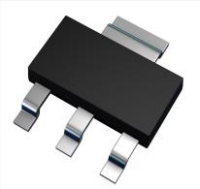
## Features and Benefits

- 100% Unclamped Inductive Switch (UIS) Test in Production
- High Voltage
- Low On-Resistance
- Fast Switching Speed
- Low Gate Drive
- Low Threshold
- **Lead-Free Finish; RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **For automotive applications requiring specific change control (i.e.: parts qualified to AEC-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please refer to the related automotive grade (Q-suffix) part. A listing can be found at https://www.diodes.com/products/automotive/automotive-products/.**
- **This part is qualified to JEDEC standards (as references in AEC-Q) for High Reliability. https://www.diodes.com/quality/product-definitions/**

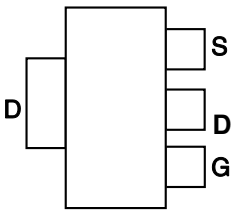
## Mechanical Data

- Package: SOT223 (Type DN)
- Package Material: Molded Plastic, "Green" Molding Compound; UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Annealed over Copper Leadframe. Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.112 grams (Approximate)

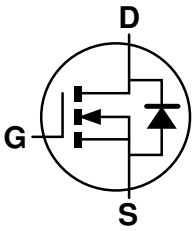
SOT223 (Type DN)



Top View




Pin Out - Top View




Equivalent Circuit

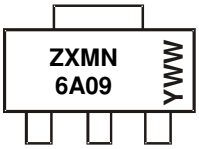
## Ordering Information (Note 4)

| Part Number | Package | Packing | |
|---|---|---|---|
| | | Qty. | Carrier |
| ZXMN6A09GTA | SOT223 (Type DN) | 1,000 | Tape & Reel |

Notes:
1. EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant. All applicable RoHS exemptions applied.
2. See https://www.diodes.com/quality/lead-free/ 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. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.

## Marking Information

SOT223 (Type DN)




ZXMN6A09 = Product Type Marking Code
YWW = Date Code Marking
Y = Last Digit of Year (ex: 2 = 2022)
WW = Week Code (01 to 53)

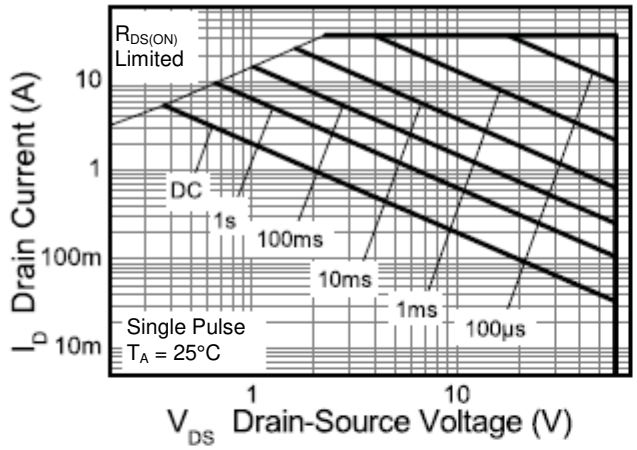
## Maximum Ratings (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DSS}$ | 60 | V |
| Gate-Source Voltage | $V_{GSS}$ | ±20 | V |
| Continuous Drain Current @$V_{GS}$ = 10V; $T_A$ = +25°C (Note 6)<br>@$V_{GS}$ = 10V; $T_A$ = +70°C (Note 6)<br>@$V_{GS}$ = 10V; $T_A$ = +25°C (Note 5) | $I_D$ | 7.5<br>6<br>5.4 | A |
| Pulsed Drain Current (Note 7) | $I_{DM}$ | 33 | A |
| Continuous Source Current (Body Diode) (Note 6) | $I_S$ | 3.5 | A |
| Pulsed Source Current (Body Diode) (Note 7) | $I_{SM}$ | 33 | A |
| Avalanche Current, L = 0.1mH | $I_{AS}$ | 1.17 | A |
| Avalanche Energy, L = 0.1mH | $E_{AS}$ | 0.07 | mJ |

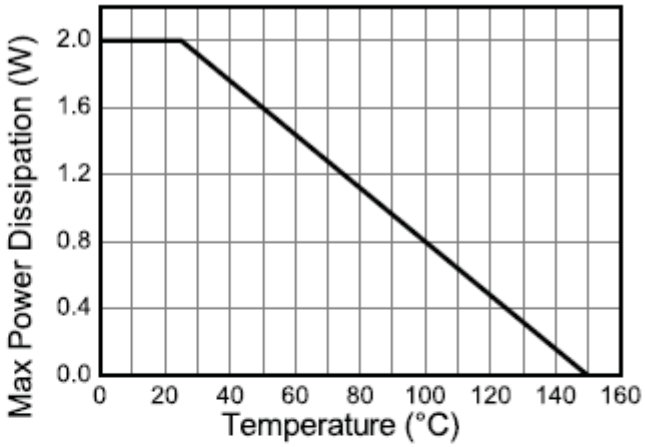
## Thermal Characteristics (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Power Dissipation at $T_A$ = +25°C (Note 5)<br>Linear Derating Factor | $P_D$ | 2.0<br>16 | W<br>mW/°C |
| Power Dissipation at $T_A$ = +25°C (Note 6)<br>Linear Derating Factor | $P_D$ | 3.9<br>31 | W<br>mW/°C |
| Thermal Resistance, Junction to Ambient (Note 5) | $R_{\theta JA}$ | 62.5 | °C/W |
| Thermal Resistance, Junction to Ambient (Note 6) | $R_{\theta JA}$ | 32.2 | °C/W |
| Operating and Storage Temperature Range | $T_J$, $T_{STG}$ | -55 to +150 | °C |

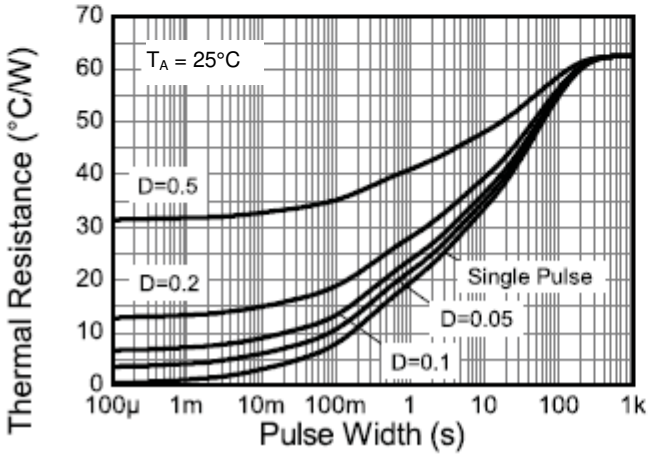
Notes: 5. For a device surface mounted on 25mm × 25mm FR-4 PCB with high coverage of single sided 1oz copper, in still air conditions.
6. For a device surface mounted on FR-4 PCB measured at t ≦10s.
7. Repetitive rating 25mm × 25mm FR-4 PCB, D = 0.02 pulse width = 300µs - pulse width limited by maximum junction temperature.



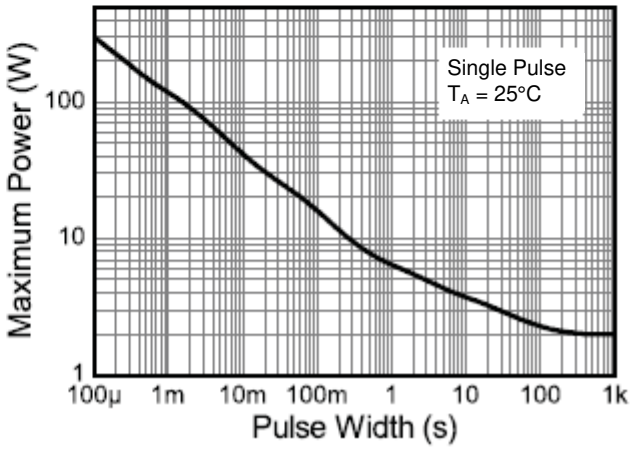

**Safe Operating Area**




**Derating Curve**




**Transient Thermal Impedance**

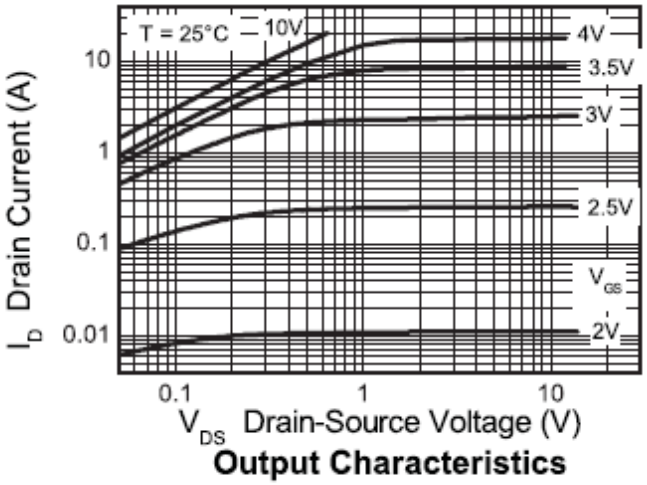



**Pulse Power Dissipation**

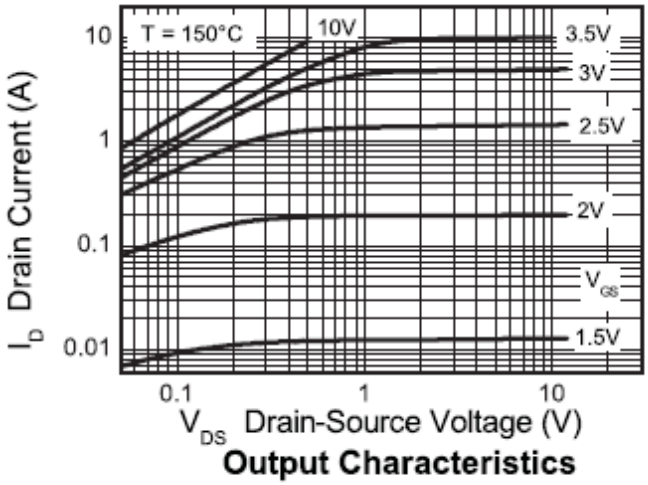
## Electrical Characteristics (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | 60 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | — | — | 1 | µA | $V_{DS}$ = 60V, $V_{GS}$ = 0V |
| Gate-Source Leakage | $I_{GSS}$ | — | — | 100 | nA | $V_{GS}$ = ±20V, $V_{DS}$ = 0V |
| **ON CHARACTERISTICS** | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | 1 | — | 3 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250µA |
| Static Drain-Source On-Resistance (Note 8) | $R_{DS(ON)}$ | — | 0.02 | 0.04 | Ω | $V_{GS}$ = 10V, $I_D$ = 8.2A |
| | | — | 0.03 | 0.06 | Ω | $V_{GS}$ = 4.5V, $I_D$ = 7.4A |
| Diode Forward Voltage (Note 8) | $V_{SD}$ | — | 0.85 | 0.95 | V | $I_S$ = 6.6A, $V_{GS}$ = 0V, $T_J$ = +25°C |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| Input Capacitance (Note 10) | $C_{iss}$ | — | 1407 | — | pF | $V_{DS}$ = 40V, $V_{GS}$ = 0V, f = 1.0MHz |
| Output Capacitance (Note 10) | $C_{oss}$ | — | 121 | — | pF | |
| Reverse Transfer Capacitance (Note 10) | $C_{rss}$ | — | 59 | — | pF | |
| Total Gate Charge (Notes 9 &10) $V_{GS}$ = 5V | $Q_g$ | — | 12.4 | — | nC | $V_{DS}$ = 15V, $I_D$ = 3.5A |
| Total Gate Charge (Notes 9 &10) $V_{GS}$ = 10V | $Q_g$ | — | 24.2 | — | nC | |
| Gate-Source Charge (Notes 9 &10) | $Q_{gs}$ | — | 5.2 | — | nC | |
| Gate-Drain Charge (Notes 9 &10) | $Q_{gd}$ | — | 3.5 | — | nC | |
| Turn-On Delay Time (Notes 9 & 10) | $t_{D(ON)}$ | — | 4.9 | — | ns | $V_{DD}$ = 15V, $I_D$ = 3.5A, $V_{GS}$ = 5V |
| Turn-On Rise Time (Note 9 & 10) | $t_R$ | — | 5.0 | — | ns | |
| Turn-Off Delay Time (Notes 9 & 10) | $t_{D(OFF)}$ | — | 25.3 | — | ns | |
| Turn-Off Fall Time (Notes 9 & 10) | $t_F$ | — | 4.6 | — | ns | |
| Reverse Recovery Time (Note 10) | $t_{RR}$ | — | 26.3 | — | ns | $I_F$ = 3.5A, di/dt = 100A/µs, $T_J$ = +25°C |
| Reverse Recovery Charge (Note 10) | $Q_{RR}$ | — | 26.6 | — | nC | |

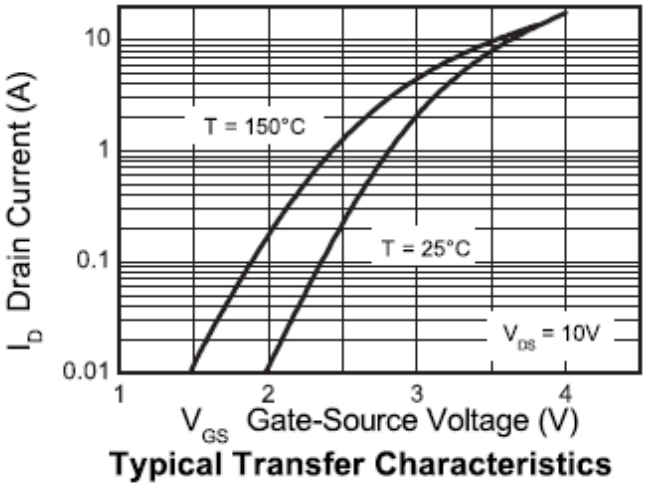
Notes: 8. Measured under pulsed conditions. Pulse width ≤ 300µs; duty cycle ≤ 2%.
9. Switching characteristics are independent of operating junction temperature.
10. For design aid only, not subject to production testing.



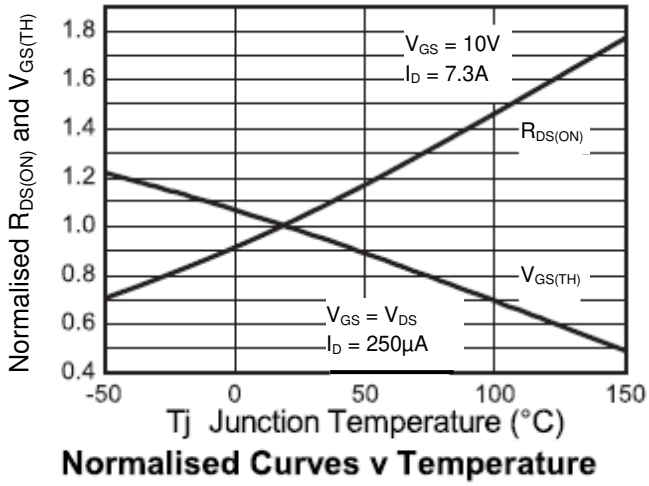

**Output Characteristics**



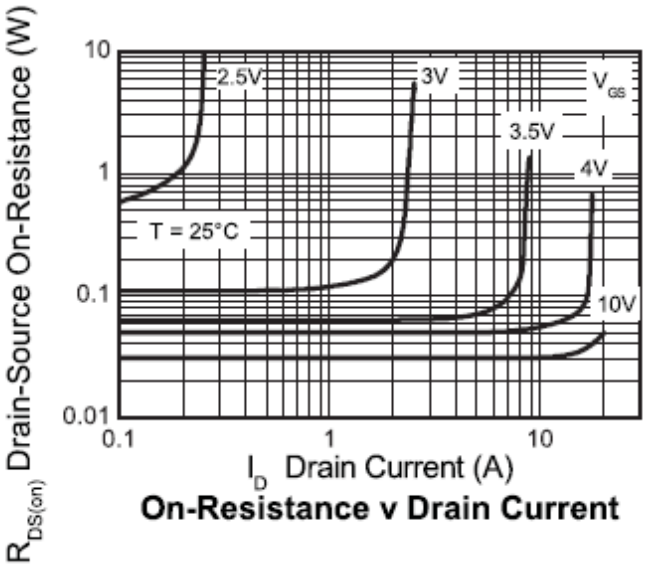

**Output Characteristics**



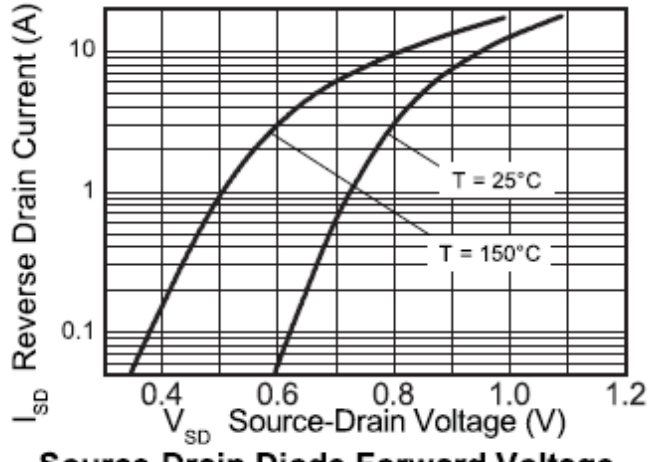

**Typical Transfer Characteristics**



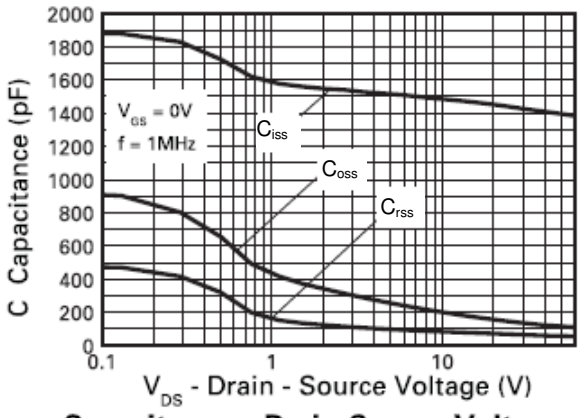

**Normalised Curves v Temperature**



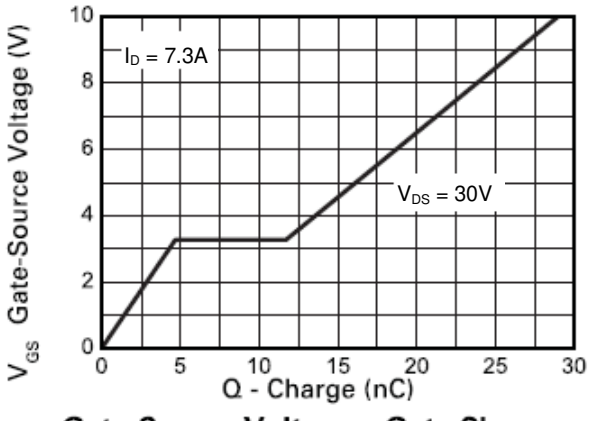

**On-Resistance v Drain Current**



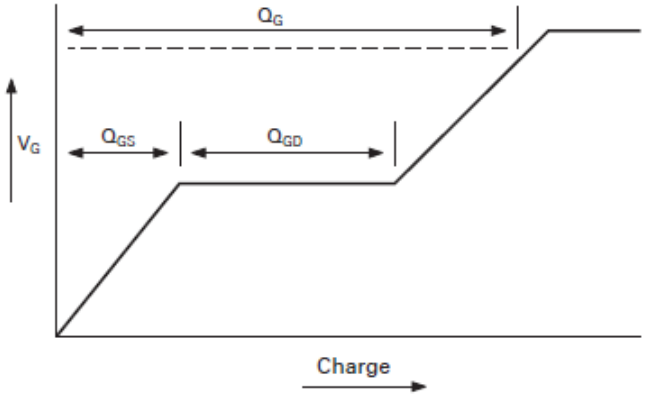

**Source-Drain Diode Forward Voltage**



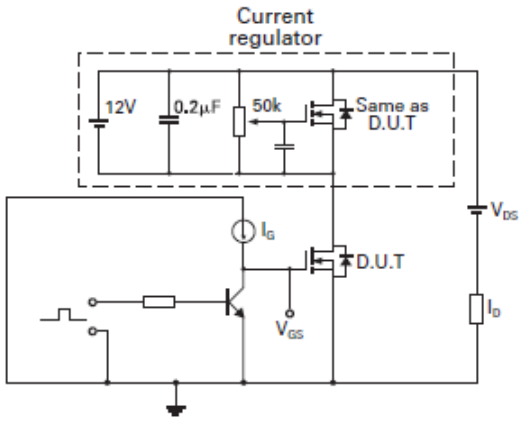

**Capacitance v Drain-Source Voltage**



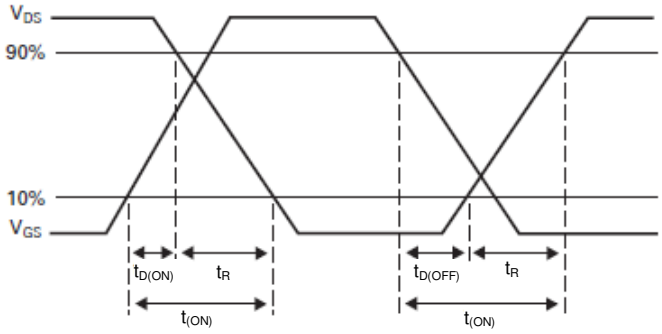

**Gate-Source Voltage v Gate Charge**



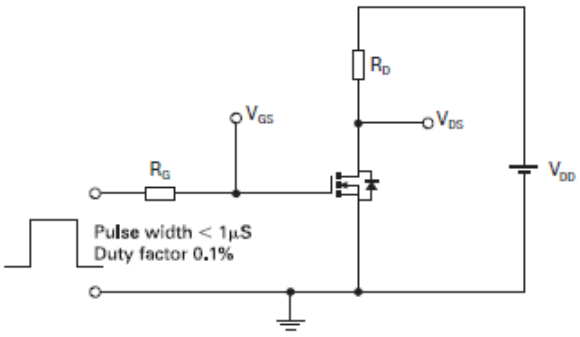

**Basic gate charge waveform**




**Gate charge test circuit**




**Switching time waveforms**

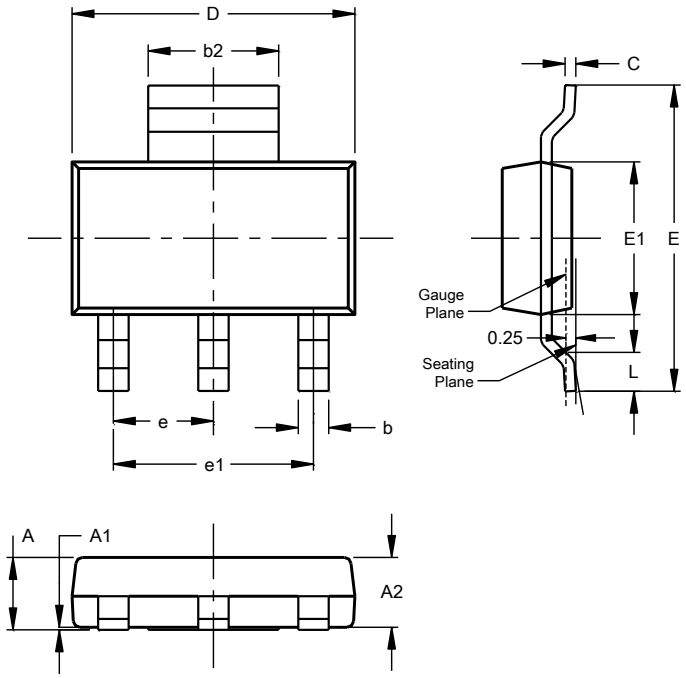



**Switching time test circuit**

## Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

**SOT223 (Type DN)**

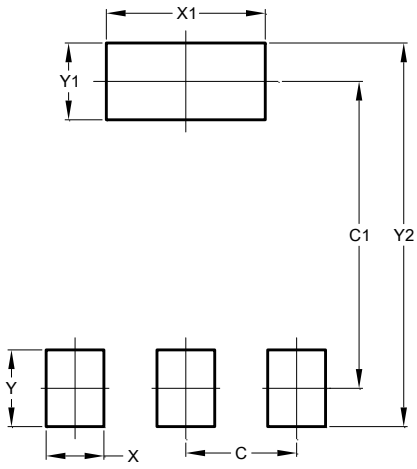



| SOT223 (Type DN) | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | -- | 1.70 | -- |
| **A1** | 0.01 | 0.15 | -- |
| **A2** | 1.50 | 1.68 | 1.60 |
| **b** | 0.60 | 0.80 | 0.70 |
| **b2** | 2.90 | 3.10 | -- |
| **c** | 0.20 | 0.32 | -- |
| **D** | 6.30 | 6.70 | -- |
| **E** | 6.70 | 7.30 | -- |
| **E1** | 3.30 | 3.70 | -- |
| **e** | -- | -- | 2.30 |
| **e1** | -- | -- | 4.60 |
| **L** | 0.85 | -- | -- |
| **All Dimensions in mm** | | | |

## Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

**SOT223 (Type DN)**




| Dimensions | Value (in mm) |
|---|---|
| **C** | 2.30 |
| **C1** | 6.40 |
| **X** | 1.20 |
| **X1** | 3.30 |
| **Y** | 1.60 |
| **Y1** | 1.60 |
| **Y2** | 8.00 |

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