# INTEGRATED RELAY AND INDUCTIVE LOAD DRIVER

## Product Summary

| $BV_{DSS}$ | $R_{DS(ON)}$ max | $I_D$ max $T_A$ = +25°C |
|---|---|---|
| 60V | 1.8Ω @ $V_{GS}$ = 5V | 630mA |
| | 2.4Ω @ $V_{GS}$ = 3V | |

## Features and Benefits

- Provides a reliable and robust interface between sensitive logic and DC relay coils
- Replaces 3 to 4 discrete components enabling PCB footprint to be reduced
- Internal active clamp removes the need for external zener diode
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **The DMN61D8LVTQ is suitable for automotive applications requiring specific change control; this part is AEC-Q101 qualified, PPAP capable, and manufactured in IATF 16949 certified facilities.**
  **https://www.diodes.com/quality/product-definitions/**

## Description and Applications

DIODES™ DMN61D8LVTQ provides a single component solution for switching inductive loads such as relays, solenoids, and small DC motors in automotive applications, without the need of a freewheeling diode. DMN61D8LVTQ accepts logic level inputs, thus allowing it to be driven by logic gates, inverters and microcontrollers. It is ideally suited for door, window and antenna relay coils.

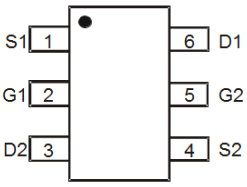
ESD Protected Gate

## Mechanical Data

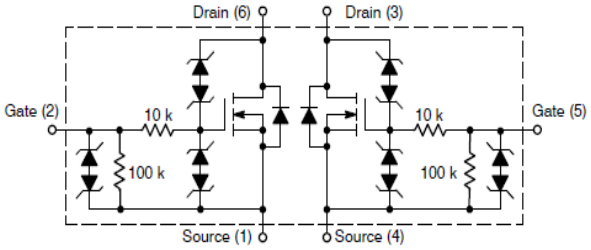
- Package: TSOT26
- Package Material: Molded Plastic, "Green" Molding Compound; UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals Connections: See Diagram
- Terminals: Finish – Matte Tin Annealed over Copper Leadframe; Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.013 grams (Approximate)

TSOT26

Top View




Top View




Equivalent Circuit

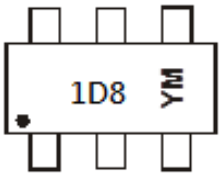
## Ordering Information (Note 4)

| Part Number | Package | Packing | |
|---|---|---|---|
| | | Qty. | Carrier |
| DMN61D8LVTQ-7 | TSOT26 | 3,000 | Tape & Reel |
| DMN61D8LVTQ-13 | TSOT26 | 10,000 | Tape & Reel |

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
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

TSOT26




1D8 = Product Type Marking Code
YM = Date Code Marking
Y or $\overline{Y}$= Year (ex: J = 2022)
M = Month (ex: 9 = September)

Date Code Key

| Year | 2015 | … | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | C | … | J | K | L | M | N | O | P | R | S | T |

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | O | N | D |

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

| Characteristic | | | Symbol | Value | Unit |
|---|---|---|---|---|---|
| Drain-Source Voltage | | | $V_{DSS}$ | 60 | V |
| Gate-Source Voltage | | | $V_{GSS}$ | ±12 | V |
| Continuous Drain Current (Note 6) | Steady State | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | 630<br>500 | mA |
| Maximum Continuous Body Diode Forward Current (Note 6) | | | $I_S$ | 0.5 | A |
| Single Pulse Drain-to-Source Avalanche Energy (For Relay's Coils/Inductive Loads of 80Ω or Higher) ($T_J$ Initial = +85°C) | | | EZ | 200 | mJ |
| Peak Power Dissipation, Drain-to-Source (Non repetitive current square pulse 1.0ms duration) ($T_J$ Initial = +85°C) | | | PPK | 20 | W |
| Load Dump Pulse, Drain-to-Source, $R_{SOURCE}$ = 0.5Ω, t = 300ms) (For Relay's Coils/Inductive Loads of 80Ω or Higher) ($T_J$ Initial = +85°C) | | | ELD1 | 60 | V |
| Inductive Switching Transient 1, Drain-to-Source (Waveform: $R_{SOURCE}$ = 10Ω, t = 2.0ms) (For Relay's Coils/Inductive Loads of 80Ω or Higher) ($T_J$ Initial = +85°C) | | | ELD2 | 100 | V |
| Inductive Switching Transient 2, Drain-to-Source (Waveform: $R_{SOURCE}$ = 4.0Ω, t = 50µs) (For Relay's Coils/Inductive Loads of 80Ω or Higher) ($T_J$ Initial = +85°C) | | | ELD3 | 300 | V |
| Reverse Battery, 10 Minutes (Drain-to-Source) (For Relay's Coils/Inductive Loads of 80Ω or more) | | | Rev−Bat | -14 | V |
| Dual Voltage Jump Start, 10 Minutes (Drain-to-Source) | | | Dual−Volt | 28 | V |
| ESD Human Body Model (HBM) | | | ESD | 4,000 | V |

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

| Characteristic | | Symbol | Value | Unit |
|---|---|---|---|---|
| Total Power Dissipation (Note 5) | | $P_D$ | 820 | mW |
| Thermal Resistance, Junction to Ambient (Note 5) | Steady State | $R_{\theta JA}$ | 154 | °C/W |
| Total Power Dissipation (Note 6) | | $P_D$ | 1,090 | mW |
| Thermal Resistance, Junction to Ambient (Note 6) | Steady State | $R_{\theta JA}$ | 116 | °C/W |
| Operating and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to +150 | °C |

Notes: 5. Device mounted on FR-4 PCB, with minimum recommended pad layout.
6. Device mounted on 1" x 1" FR-4 PCB with high coverage 2oz. copper, single sided.

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

| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (Note 7)** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | 60 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 10mA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | — | — | 50<br>0.5 | μA | $V_{DS}$ = 60V, $V_{GS}$ = 0V<br>$V_{DS}$ = 12V, $V_{GS}$ = 0V |
| Gate-Source Leakage | $I_{GSS}$ | — | — | ±90<br>±60 | μA | $V_{GS}$ = ±5V, $V_{DS}$ = 0V<br>$V_{GS}$ = ±3V, $V_{DS}$ = 0V |
| **ON CHARACTERISTICS (Note 7)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | 1.3 | — | 2.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 1mA |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | — | 1.1<br>1.4 | 1.8<br>2.4 | Ω | $V_{GS}$ = 5V, $I_D$ = 0.15A<br>$V_{GS}$ = 3V, $I_D$ = 0.15A |
| Forward Transfer Admittance | $\|Y_{fs}\|$ | 80 | — | — | ms | $V_{DS}$ = 12V, $I_D$ = 0.15A |
| Diode Forward Voltage | $V_{SD}$ | — | 0.8 | 1.2 | V | $V_{GS}$ = 0V, $I_S$ = 0.15A |
| **DYNAMIC CHARACTERISTICS (Note 8)** | | | | | | |
| Input Capacitance | $C_{iss}$ | — | 12.9 | — | pF | $V_{DS}$ = 12V, $V_{GS}$ = 0V<br>f = 1.0MHz |
| Output Capacitance | $C_{oss}$ | — | 17 | — | pF | |
| Reverse Transfer Capacitance | $C_{rss}$ | — | 0.84 | — | pF | |
| Total Gate Charge | $Q_g$ | — | 0.74 | — | nC | $V_{GS}$ = 5V, $V_{DS}$ = 12V,<br>$I_D$ =150mA |
| Gate-Source Charge | $Q_{gs}$ | — | 0.19 | — | nC | |
| Gate-Drain Charge | $Q_{gd}$ | — | 0.16 | — | nC | |
| Turn-On Delay Time | $t_{D(ON)}$ | — | 131 | — | ns | $V_{DD}$ = 12V, $V_{GS}$ = 5V |
| Turn-On Rise Time | $t_R$ | — | 301 | — | ns | |
| Turn-Off Delay Time | $t_{D(OFF)}$ | — | 582 | — | ns | |
| Turn-Off Fall Time | $t_F$ | — | 440 | — | ns | |

Notes: 7. Short duration pulse test used to minimize self-heating effect.
8. Guaranteed by design. Not subject to product testing.

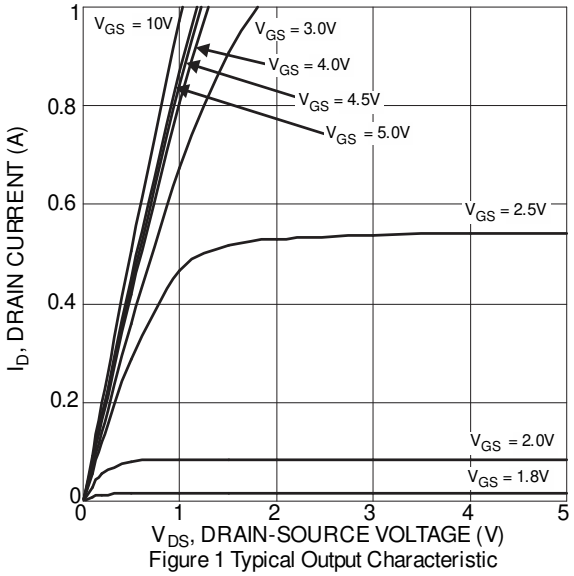


Figure 1 Typical Output Characteristic

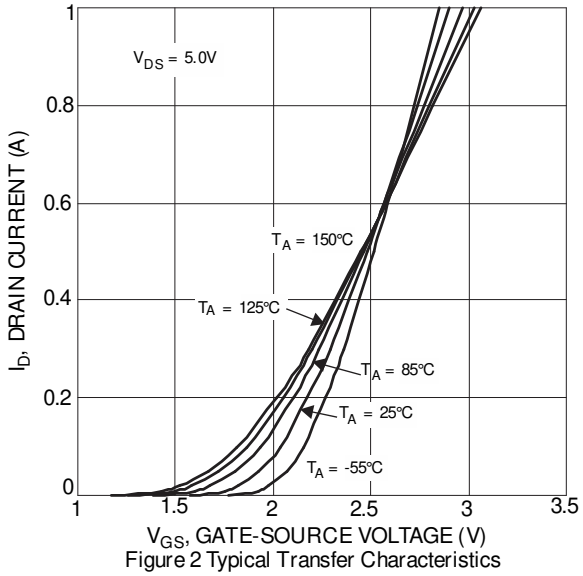


Figure 2 Typical Transfer Characteristics

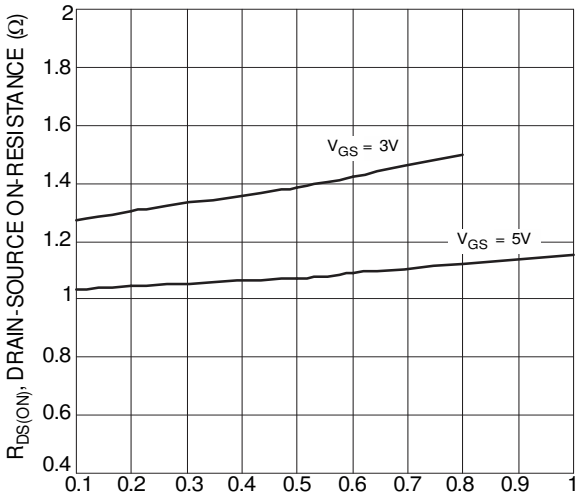


Figure 3 Typical On-Resistance vs. Drain Current and Gate Voltage

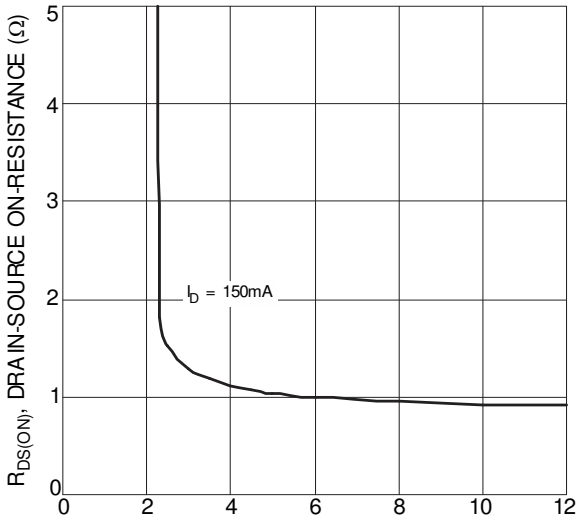


Figure 4 Typical Transfer Characteristic

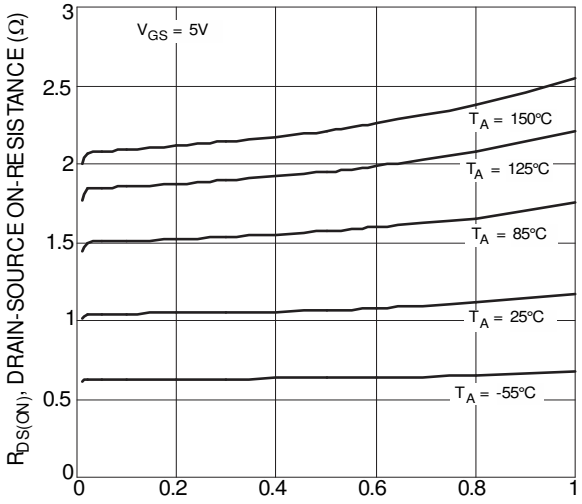


Figure 5 Typical On-Resistance vs. Drain Current and Temperature

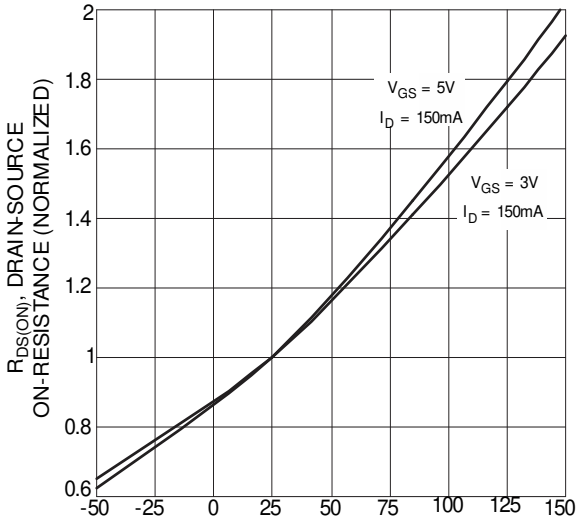


Figure 6 On-Resistance Variation with Temperature

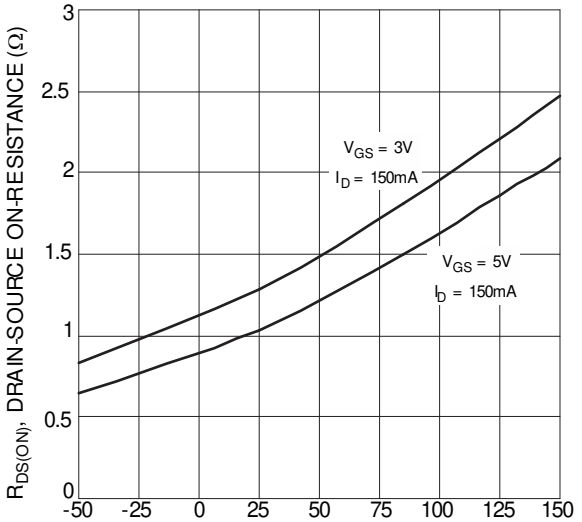


Figure 7 On-Resistance Variation with Temperature

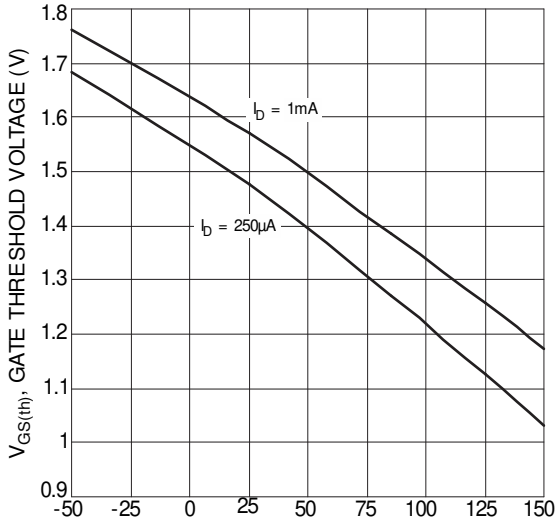


Figure 8 Gate Threshold Variation vs. Junction Temperature

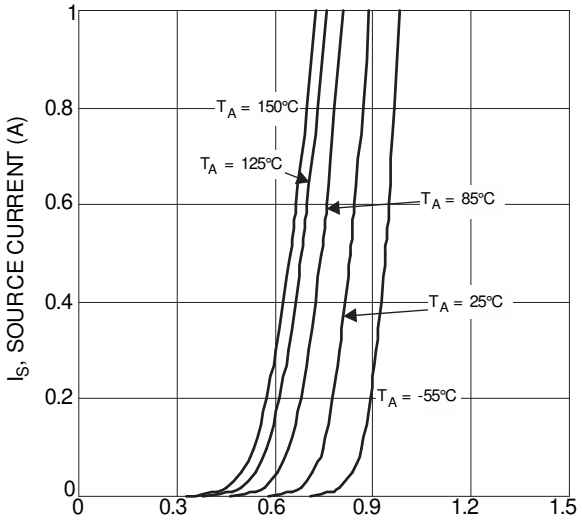


Figure 9 Diode Forward Voltage vs. Current

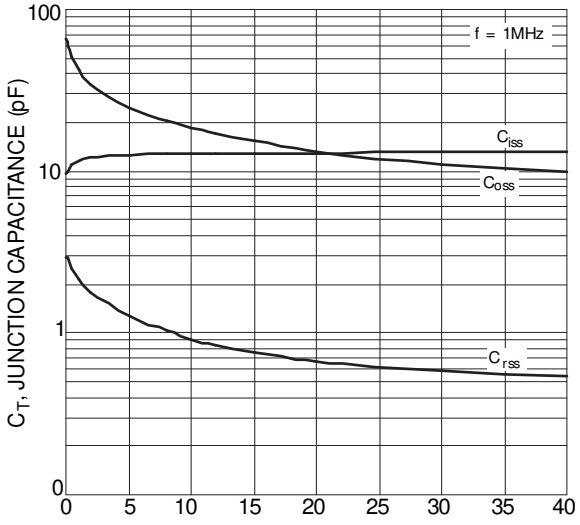


Figure 10 Typical Junction Capacitance

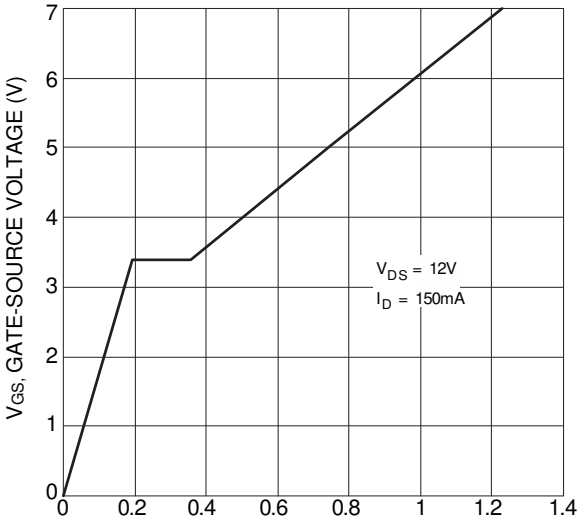


Figure 11 Gate Charge

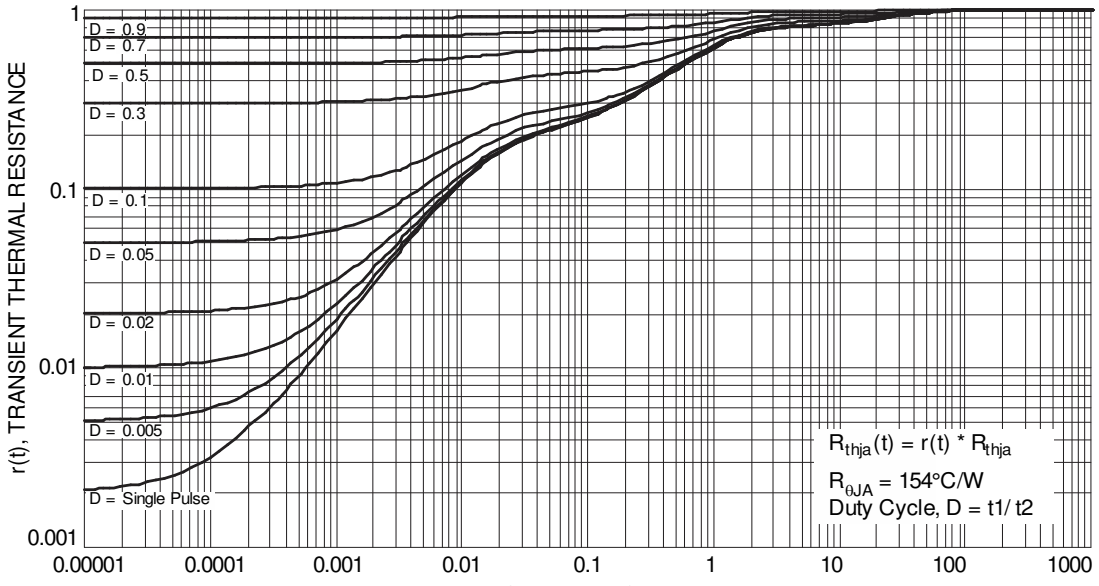
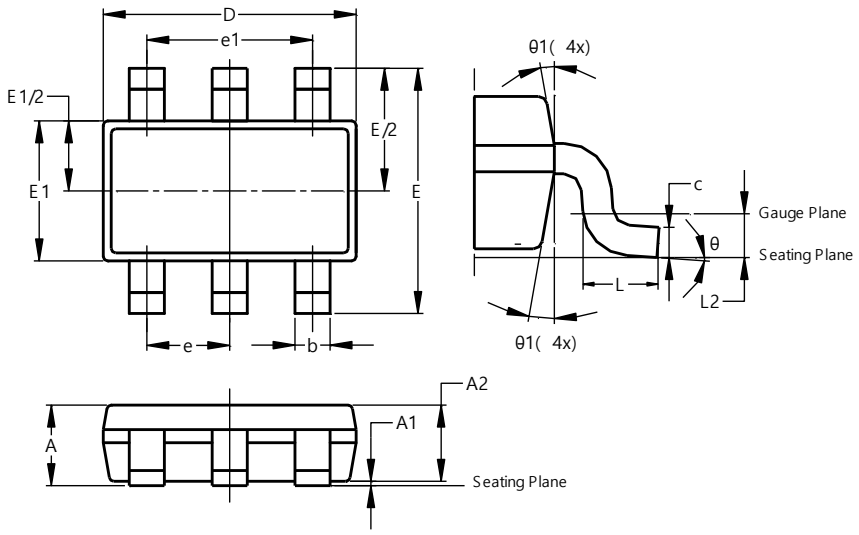


Figure 12 Transient Thermal Resistance

## Package Outline Dimensions

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

**TSOT26**

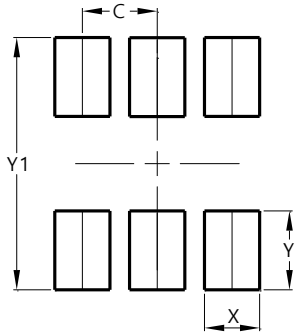



| TSOT26 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | – | 1.00 | – |
| **A1** | 0.010 | 0.100 | – |
| **A2** | 0.840 | 0.900 | – |
| **D** | 2.800 | 3.000 | 2.900 |
| **E** | 2.800 BSC | | |
| **E1** | 1.500 | 1.700 | 1.600 |
| **b** | 0.300 | 0.450 | – |
| **c** | 0.120 | 0.200 | – |
| **e** | 0.950 BSC | | |
| **e1** | 1.900 BSC | | |
| **L** | 0.30 | 0.50 | – |
| **L2** | 0.250 BSC | | |
| **θ** | 0° | 8° | 4° |
| **θ1** | 4° | 12° | – |
| **All Dimensions in mm** | | | |

## Suggested Pad Layout

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

**TSOT26**




| Dimensions | Value (in mm) |
|---|---|
| **C** | 0.950 |
| **X** | 0.700 |
| **Y** | 1.000 |
| **Y1** | 3.200 |

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