# 20V N-CHANNEL ENHANCEMENT MODE MOSFET
## PowerDI3333-8

## Product Summary

| $BV_{DSS}$ | $R_{DS(ON)}$ Max | $I_D$ Max $T_C$ = +25°C (Note 10) |
|---|---|---|
| 20V | 4.6mΩ @ $V_{GS}$ = 4.5V | 50A |
| | 8.7mΩ @ $V_{GS}$ = 2.5V | 36A |

## Features and Benefits

- Low $R_{DS(ON)}$—Ensures On-State Losses are Minimized
- Small-Form Factor Thermally Efficient Package Enables Higher Density End Products
- Occupies 33% of the Board Area Occupied by SO-8 Enabling Smaller End Product
- 100% Unclamped Inductive Switching, Test in Production—Ensures More Reliable And Robust End Application
- **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)**

## Description and Applications

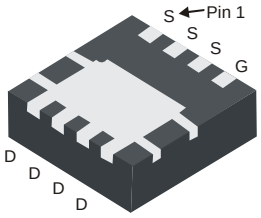
This MOSFET is designed to meet the stringent requirements of automotive applications. It is qualified to AEC-Q101, supported by a PPAP, and is ideal for use in:

- Motor Control
- Load Switch
- DC-DC Converters

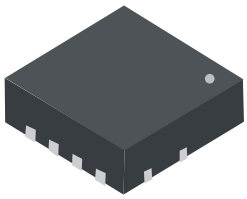
## Mechanical Data

- Case: PowerDI®3333-8
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminal Connections Indicator: See Diagram
- Terminals: Finish—Matte Tin Annealed over Copper Leadframe. Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.072 grams (Approximate)

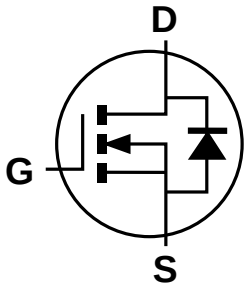
PowerDI3333-8




Bottom View



Top View



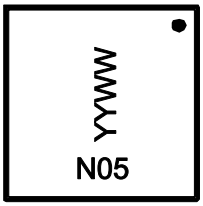

Equivalent Circuit

## Ordering Information (Note 5)

| Part Number | Case | Packaging |
|---|---|---|
| DMN2005UFGQ-7 | PowerDI3333-8 | 2000/Tape & Reel |
| DMN2005UFGQ-13 | PowerDI3333-8 | 3000/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. Automotive products are AEC-Q101 qualified and are PPAP capable. Refer to https://www.diodes.com/quality/.
5. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.

## Marking Information




N05= Product Type Marking Code
YYWW = Date Code Marking
YY = Last Two Digits of Year (ex: 19 = 2019)
WW = Week Code (01 to 53)

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

| Characteristic | | | Symbol | Value | Unit |
|---|---|---|---|---|---|
| Drain-Source Voltage | | | $V_{DSS}$ | 20 | V |
| Gate-Source Voltage | | | $V_{GSS}$ | ±12 | V |
| Continuous Drain Current (Notes 7&10) $V_{GS}$ = 4.5V | Steady State | $T_C$ = +25°C<br>$T_C$ = +70°C | $I_D$ | 50<br>40 | A |
| | | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | 18<br>14 | A |
| Pulsed Drain Current (10µs Pulse, Duty Cycle = 1%) | | | $I_{DM}$ | 130 | A |
| Maximum Continuous Body Diode Forward Current (Note 7) | | | $I_S$ | 2.6 | A |
| Avalanche Current , L = 0.2mH | | | $I_{AS}$ | 23.9 | A |
| Repetitive Avalanche Energy, L = 0.2mH | | | $E_{AS}$ | 58.4 | mJ |

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

| Characteristic | | Symbol | Value | Unit |
|---|---|---|---|---|
| Total Power Dissipation (Note 6) | $T_A$ = +25°C | $P_D$ | 1.05 | W |
| Thermal Resistance, Junction to Ambient (Note 6) | Steady State | $R_{\Theta JA}$ | 120 | °C/W |
| Total Power Dissipation (Note 7) | $T_A$ = +25°C | $P_D$ | 2.27 | W |
| Thermal Resistance, Junction to Ambient (Note 7) | Steady State | $R_{\Theta JA}$ | 55 | °C/W |
| Thermal Resistance, Junction to Case (Note 7) | | $R_{\Theta JC}$ | 6.1 | |
| Operating and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to +150 | °C |

Notes: 6. Device mounted on FR-4 PC board, with minimum recommended pad layout, single sided.
7. Device mounted on FR-4 substrate PC board, 2oz copper, with thermal bias to bottom layer 1inch square copper plate.

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

| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (Note 8)** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | 20 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| Zero Gate Voltage Drain Current $T_J$ = +25°C | $I_{DSS}$ | — | — | 10 | µA | $V_{DS}$ = 20V, $V_{GS}$ = 0V |
| Gate-Source Leakage | $I_{GSS}$ | — | — | ±100 | nA | $V_{GS}$ = ±12V, $V_{DS}$ = 0V |
| **ON CHARACTERISTICS (Note 8)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | 0.4 | 0.7 | 1.2 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250µA |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | — | 4 | 4.6 | mΩ | $V_{GS}$ = 4.5V, $I_D$ = 13.5A |
| | | — | 4.9 | 8.7 | | $V_{GS}$ = 2.5V, $I_D$ = 13.5A |
| Diode Forward Voltage | $V_{SD}$ | — | 0.8 | 1.1 | V | $V_{GS}$ = 0V, $I_S$ = 27A |
| **DYNAMIC CHARACTERISTICS (Note 9)** | | | | | | |
| Input Capacitance | $C_{iss}$ | — | 6,495 | — | pF | $V_{DS}$ = 10V, $V_{GS}$ = 0V, f = 1MHz |
| Output Capacitance | $C_{oss}$ | — | 546 | — | pF | |
| Reverse Transfer Capacitance | $C_{rss}$ | — | 477 | — | pF | |
| Gate Resistance | $R_g$ | — | 0.7 | — | Ω | $V_{DS}$ = 0V, $V_{GS}$ = 0V, f = 1MHz |
| Total Gate Charge ($V_{GS}$ = 4.5V) | $Q_g$ | — | 68.8 | — | nC | $V_{DS}$ = 16V, $I_D$ = 27A |
| Total Gate Charge ($V_{GS}$ = 10V) | $Q_g$ | — | 164 | — | nC | |
| Gate-Source Charge | $Q_{gs}$ | — | 10.4 | — | nC | |
| Gate-Drain Charge | $Q_{gd}$ | — | 17.4 | — | nC | |
| Turn-On Delay Time | $t_{D(ON)}$ | — | 12.4 | — | ns | $V_{GS}$ = 5V, $V_{DS}$ = 10V, $R_G$ = 4.7Ω, $I_D$ = 13.5A |
| Turn-On Rise Time | $t_R$ | — | 25.7 | — | ns | |
| Turn-Off Delay Time | $t_{D(OFF)}$ | — | 114 | — | ns | |
| Turn-Off Fall Time | $t_F$ | — | 38 | — | ns | |
| Body Diode Reverse Recovery Time | $t_{RR}$ | — | 16.1 | — | ns | $I_F$ = 13.5A, di/dt = 100A/µs |
| Body Diode Reverse Recovery Charge | $Q_{RR}$ | — | 8.5 | — | nC | $I_F$ = 13.5A, di/dt = 100A/µs |

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

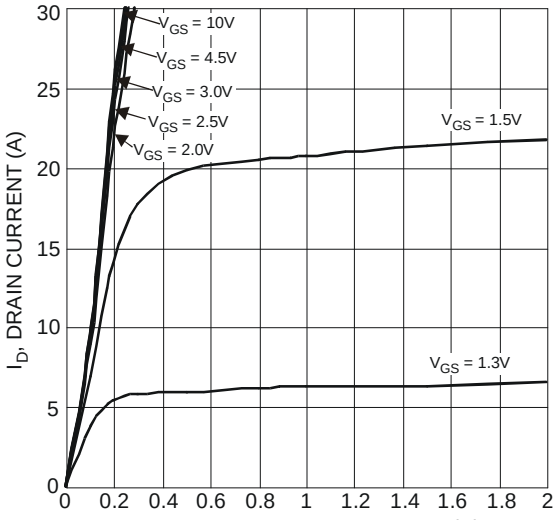


Figure 1 Typical Output Characteristics

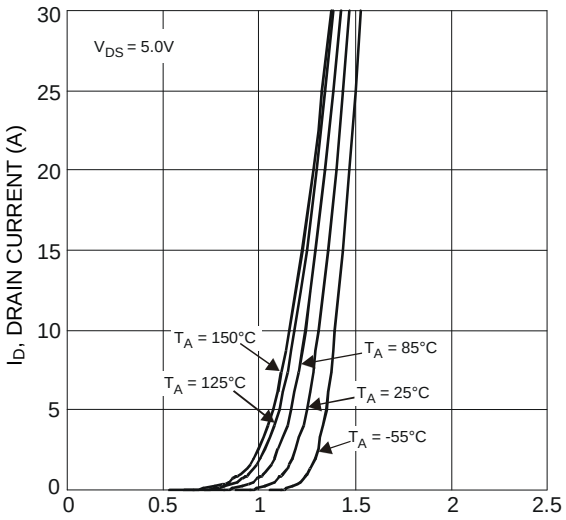


Figure 2 Typical Transfer Characteristics

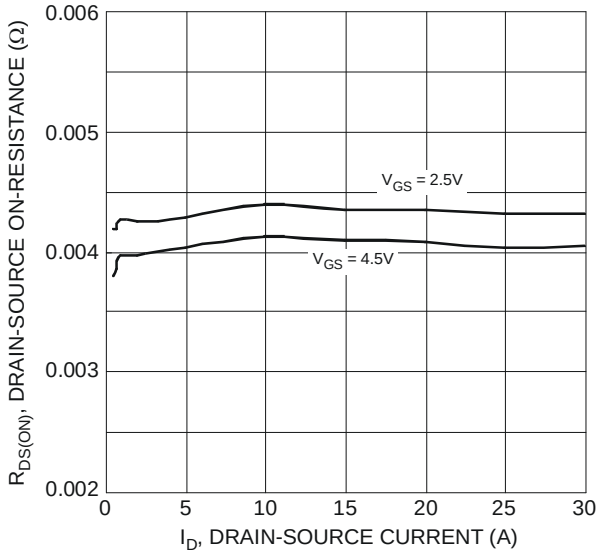



Figure 3 Typical On-Resistance vs. Drain Current and Gate Voltage

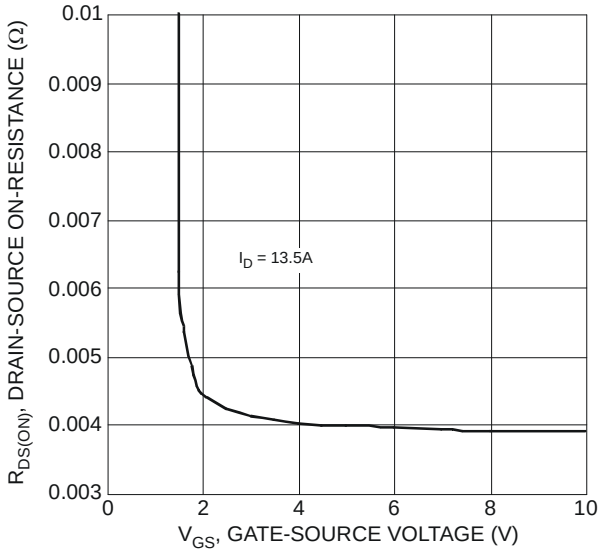



Figure 4 Typical Transfer Characteristic

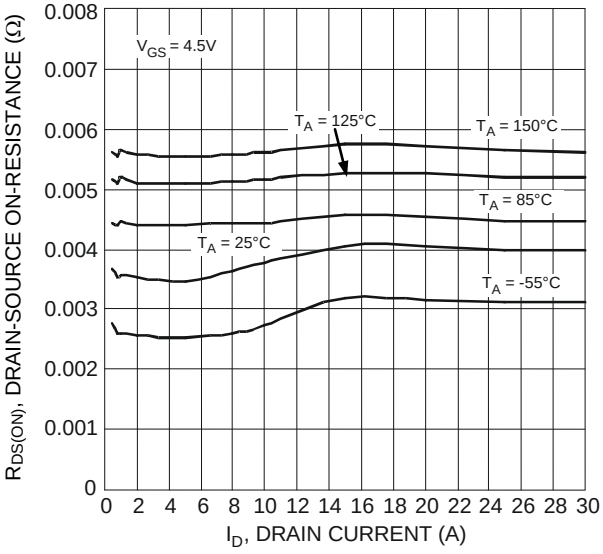



Figure 5 Typical On-Resistance vs. Drain Current and Temperature

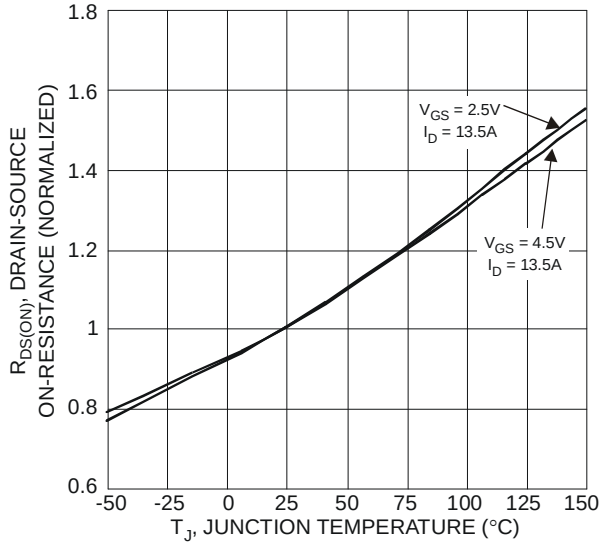



Figure 6 On-Resistance Variation with Temperature

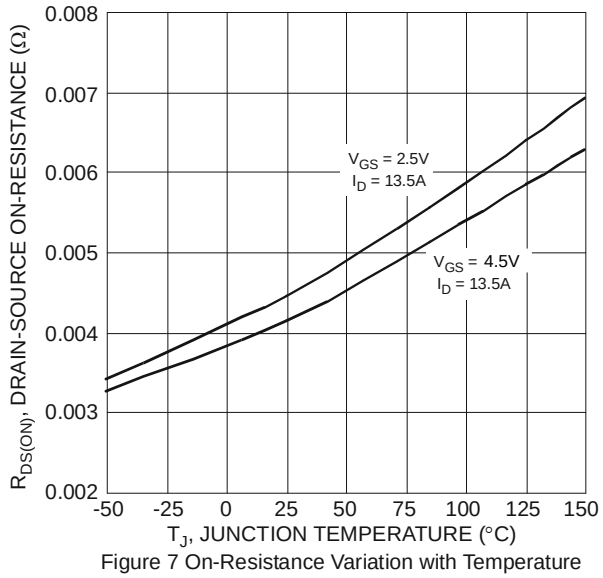



Figure 7 On-Resistance Variation with Temperature

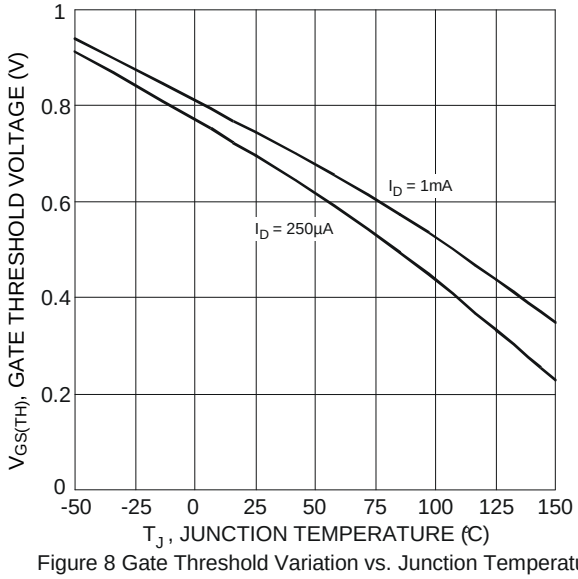



Figure 8 Gate Threshold Variation vs. Junction Temperature

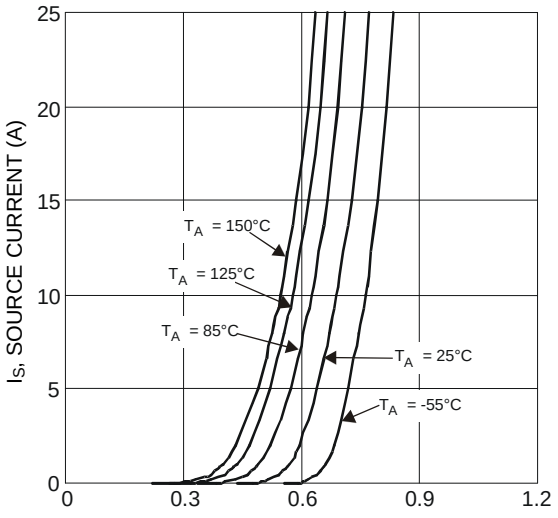


Figure 9 Diode Forward Voltage vs. Current

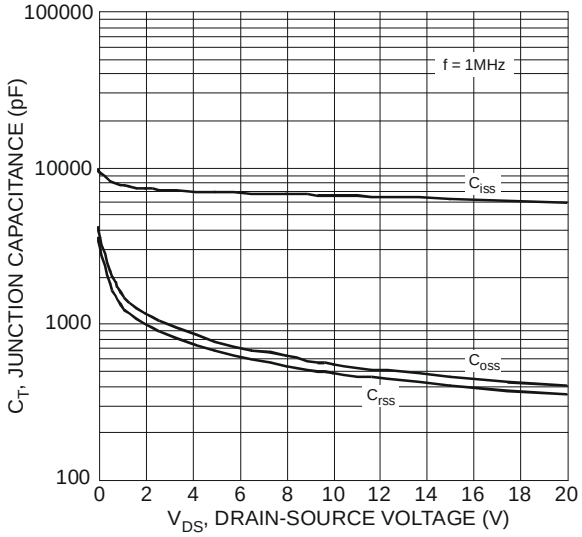


Figure 10 Typical Junction Capacitance

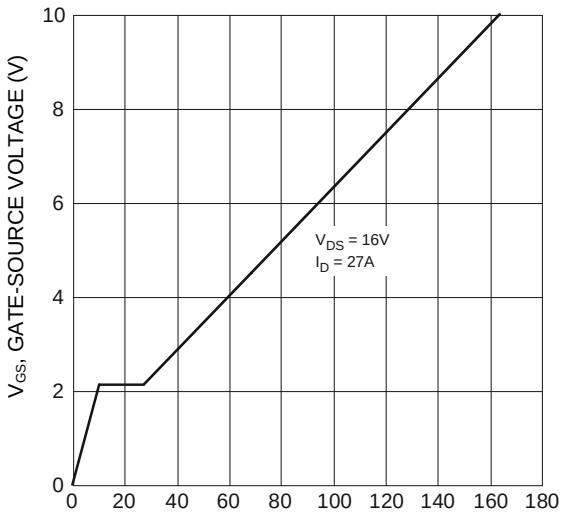


Figure 11 Gate Charge

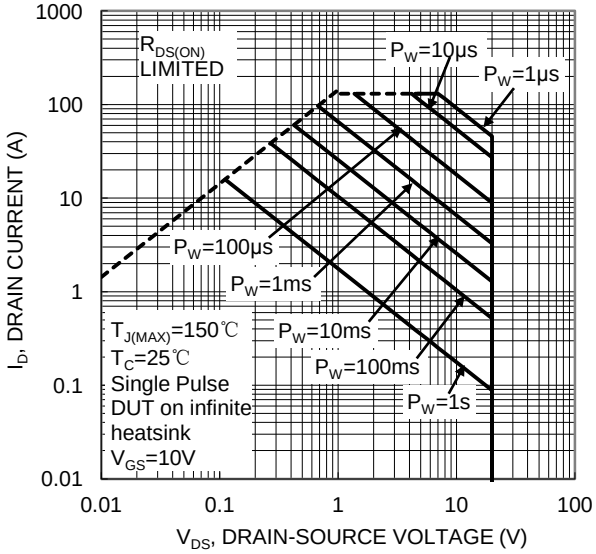


Figure 12. SOA, Safe Operation Area

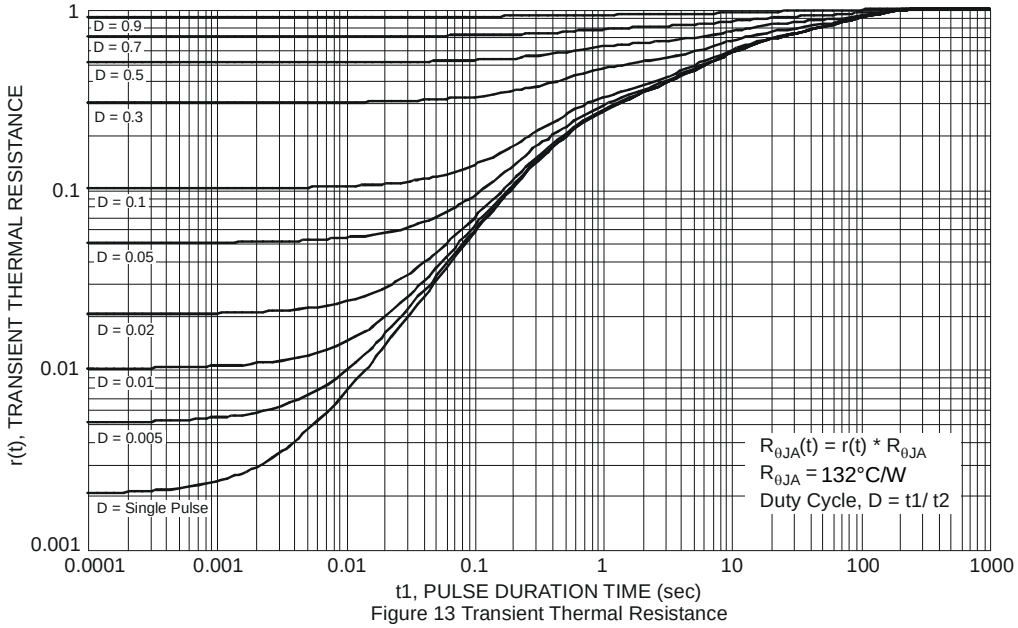
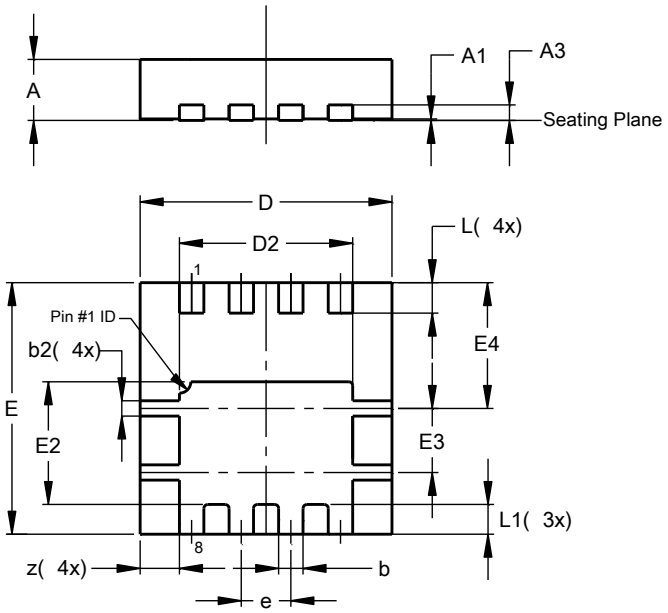


Figure 13 Transient Thermal Resistance

## Package Outline Dimensions

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

**PowerDI3333-8**

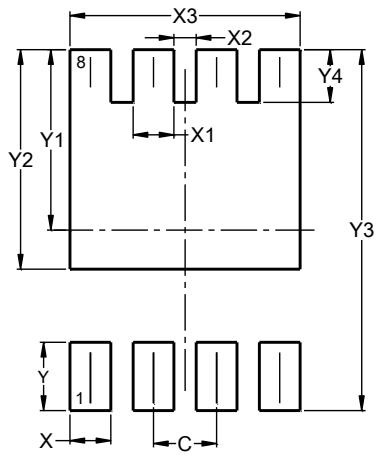



| PowerDI3333-8 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 0.75 | 0.85 | 0.80 |
| **A1** | 0.00 | 0.05 | 0.02 |
| **A3** | – | – | 0.203 |
| **b** | 0.27 | 0.37 | 0.32 |
| **b2** | 0.15 | 0.25 | 0.20 |
| **D** | 3.25 | 3.35 | 3.30 |
| **D2** | 2.22 | 2.32 | 2.27 |
| **E** | 3.25 | 3.35 | 3.30 |
| **E2** | 1.56 | 1.66 | 1.61 |
| **E3** | 0.79 | 0.89 | 0.84 |
| **E4** | 1.60 | 1.70 | 1.65 |
| **e** | – | – | 0.65 |
| **L** | 0.35 | 0.45 | 0.40 |
| **L1** | – | – | 0.39 |
| **z** | – | – | 0.515 |
| **All Dimensions in mm** | | | |

## Suggested Pad Layout

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

**PowerDI3333-8**




| Dimensions | Value (in mm) |
|---|---|
| **C** | 0.650 |
| **X** | 0.420 |
| **X1** | 0.420 |
| **X2** | 0.230 |
| **X3** | 2.370 |
| **Y** | 0.700 |
| **Y1** | 1.850 |
| **Y2** | 2.250 |
| **Y3** | 3.700 |
| **Y4** | 0.540 |

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