# 优尚

YOUSHANG SEMICONDUCTOR

## 设计研发新型功率器件

各类小信号开关

中低压及高压大电流等场效应管

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## Product Summary

| $BV_{DSS}$ | $R_{DS(ON)}$ Max | $I_D$ Max<br>$T_A$ = +25°C |
|---|---|---|
| 30V | 11mΩ @ $V_{GS}$ = 10V | 10.5A |
| | 15mΩ @ $V_{GS}$ = 4.5V | 9.2A |

## Description and Applications

This MOSFET has been designed to minimize the on-state resistance ($R_{DS(ON)}$) yet maintain superior switching performance, making it ideal for high-efficiency power-management applications.

- Backlighting
- Power-management functions
- DC-DC converters

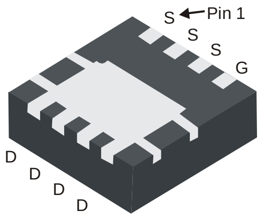
## Features and Benefits

- Low $R_{DS(ON)}$ – Ensures On-State Losses Are Minimized
- Small Form Factor Thermally Efficient Package Enables Higher Density End Products
- Occupies Just 33% of The Board Area Occupied by SO-8 Enabling Smaller End Product

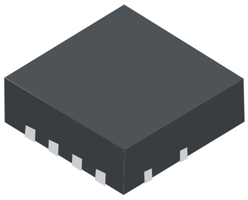
## Mechanical Data

- Package: PowerDI®3333-8
- Package 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 — NiPdAu over Copper Leadframe. Solderable per MIL-STD-202, Method 208 e4
- Weight: 0.034 grams (Approximate)

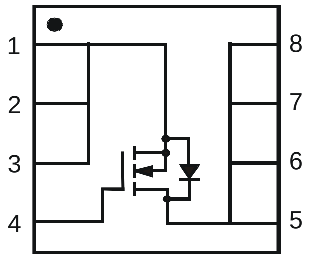
**PowerDI3333-8**



Bottom View



Top View



Top View
Internal Schematic

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

| Characteristic | | | Symbol | Value | Unit |
|---|---|---|---|---|---|
| Drain-Source Voltage | | | $V_{DSS}$ | 30 | V |
| Gate-Source Voltage | | | $V_{GSS}$ | ±20 | V |
| Continuous Drain Current (Note 6) $V_{GS}$ = 10V | Steady State | $T_A$ = +25°C | $I_D$ | 10.5 | A |
| | | $T_A$ = +70°C | | 8.5 | |
| | t<10s | $T_A$ = +25°C | $I_D$ | 14 | A |
| | | $T_A$ = +70°C | | 11 | |
| Pulsed Drain Current (10µs Pulse, Duty Cycle = 1%) | | | $I_{DM}$ | 90 | A |
| Maximum Continuous Body Diode Forward Current (Note 6) | | | $I_S$ | 3.0 | A |
| Avalanche Current (Note 7) L = 0.1mH | | | $I_{AR}$ | 22 | A |
| Repetitive Avalanche Energy (Note 7) L = 0.1mH | | | $E_{AR}$ | 24 | mJ |

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

| Characteristic | | Symbol | Value | Unit |
|---|---|---|---|---|
| Total Power Dissipation (Note 5) | Steady State | $P_D$ | 0.9 | W |
| | t<10s | | 1.5 | |
| Thermal Resistance, Junction to Ambient (Note 5) | Steady State | $R_{\theta JA}$ | 142 | °C/W |
| | t<10s | | 78 | |
| Total Power Dissipation (Note 6) | Steady State | $P_D$ | 2.2 | W |
| | t<10s | | 3.5 | |
| Thermal Resistance, Junction to Ambient (Note 6) | Steady State | $R_{\theta JA}$ | 59 | °C/W |
| | t<10s | | 33 | |
| Thermal Resistance, Junction to Case (Note 6) | | $R_{\theta JC}$ | 11 | |
| Operating and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to +150 | °C |

Notes:
5. Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.
6. Device mounted on FR-4 substrate PC board, 2oz copper, with 1inch square copper plate.
7. $I_{AR}$ and $E_{AR}$ ratings are based on low frequency and duty cycles to keep $T_J$ = +25°C.

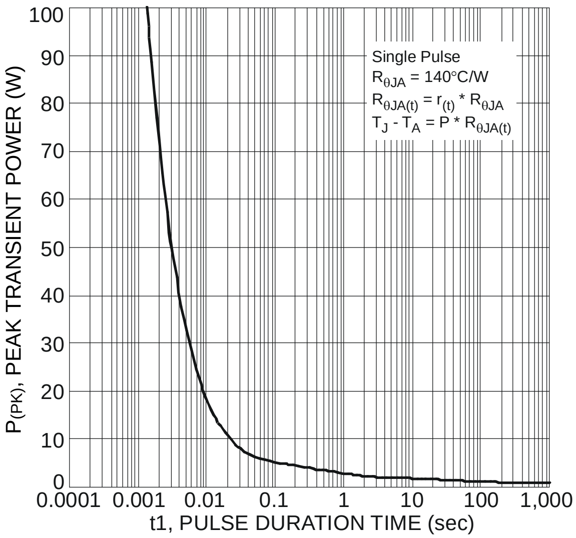


Fig. 1 Single Pulse Maximum Power Dissipation

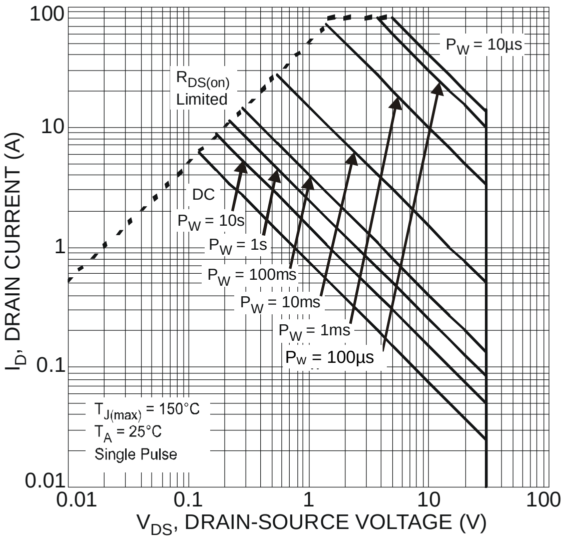


Fig. 2 SOA, Safe Operation Area

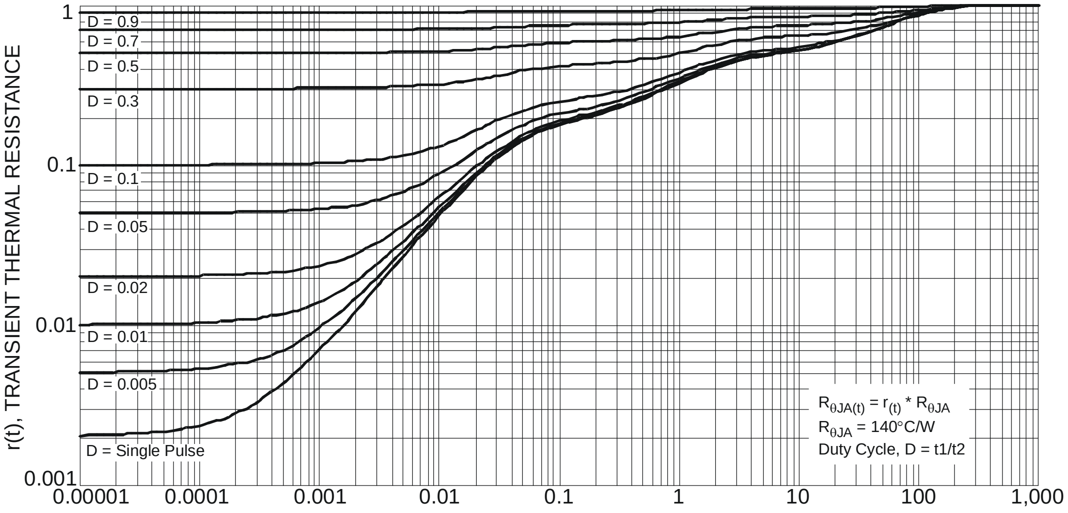


Fig. 3 Transient Thermal Resistance

## 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 | $BV_{DSS}$ | 30 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250μA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | — | — | 1 | μA | $V_{DS}$ = 30V, $V_{GS}$ = 0V |
| Gate-Source Leakage | $I_{GSS}$ | — | — | ±100 | nA | $V_{GS}$ = ±20V, $V_{DS}$ = 0V |
| **ON CHARACTERISTICS (Note 8)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | 1.4 | — | 2.5 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | — | 7 | 11 | mΩ | $V_{GS}$ = 10V, $I_D$ = 20A |
| | | — | 11 | 15 | | $V_{GS}$ = 4.5V, $I_D$ = 20A |
| Forward Transfer Admittance | $\|Y_{fs}\|$ | — | 74 | — | S | $V_{DS}$ = 5V, $I_D$ = 20A |
| Diode Forward Voltage | $V_{SD}$ | — | 0.75 | 1.0 | V | $V_{GS}$ = 0V, $I_S$ = 1A |
| **DYNAMIC CHARACTERISTICS (Note 9)** | | | | | | |
| Input Capacitance | $C_{iss}$ | — | 1281 | — | pF | $V_{DS}$ = 15V, $V_{GS}$ = 0V,<br>f = 1.0MHz |
| Output Capacitance | $C_{oss}$ | — | 145 | — | pF | |
| Reverse Transfer Capacitance | $C_{rss}$ | — | 125 | — | pF | |
| Gate Resistance | $R_g$ | — | 1.2 | — | Ω | $V_{DS}$ = 0V, $V_{GS}$ = 0V, f = 1.0MHz |
| Total Gate Charge ($V_{GS}$ = 4.5V) | $Q_g$ | — | 12.5 | — | nC | $V_{DS}$ = 15V, $I_D$ = 12A |
| Total Gate Charge ($V_{GS}$ = 10V) | $Q_g$ | — | 26.7 | — | nC | |
| Gate-Source Charge | $Q_{gs}$ | — | 3.6 | — | nC | |
| Gate-Drain Charge | $Q_{gd}$ | — | 4.4 | — | nC | |
| Turn-On Delay Time | $t_{D(ON)}$ | — | 5.2 | — | ns | $V_{DD}$ = 15V, $V_{GS}$ = 10V,<br>$R_L$ = 1.25Ω, $R_G$ = 3Ω |
| Turn-On Rise Time | $t_R$ | — | 21.2 | — | ns | |
| Turn-Off Delay Time | $t_{D(OFF)}$ | — | 22.3 | — | ns | |
| Turn-Off Fall Time | $t_F$ | — | 5.1 | — | ns | |
| Reverse Recovery Time | $t_{RR}$ | — | 8.5 | — | ns | $I_F$ = 12A, di/dt = 500A/μs |
| Reverse Recovery Charge | $Q_{RR}$ | — | 7.0 | — | nC | $I_F$ = 12A, di/dt = 500A/μs |

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

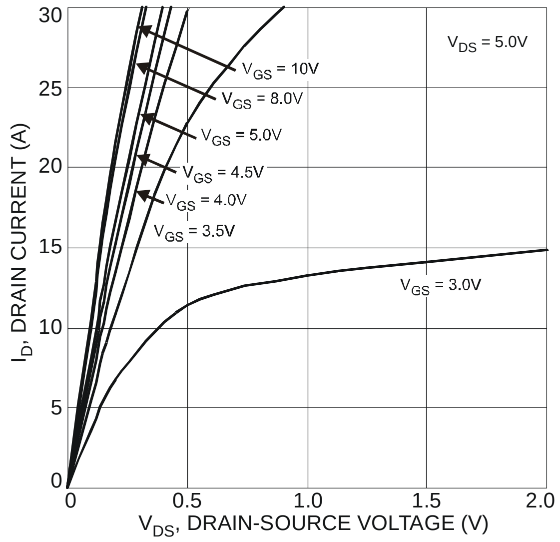


Fig.4 Typical Output Characteristic

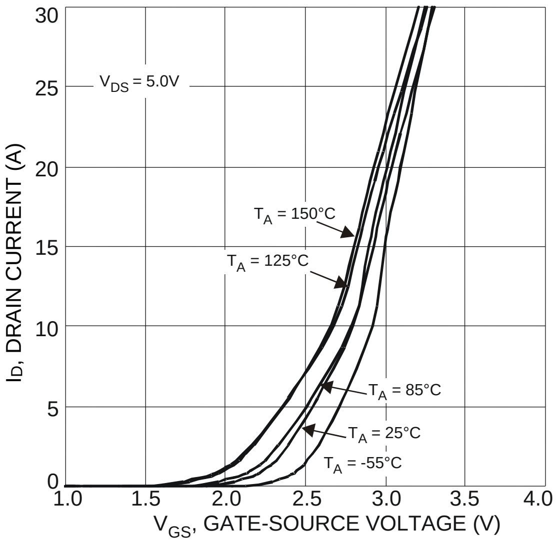


Fig. 5 Typical Transfer Characteristics

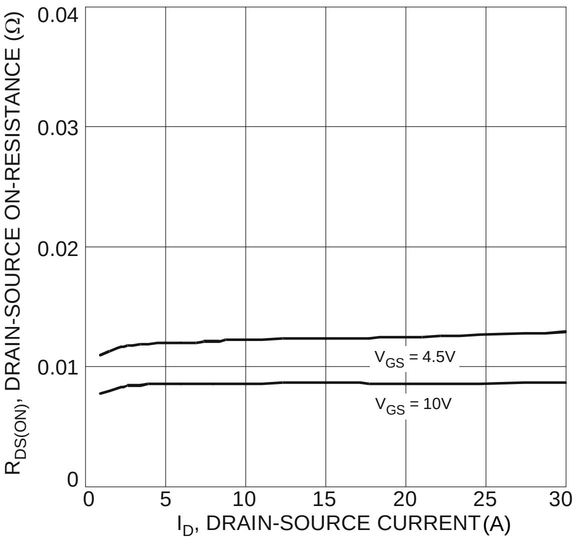


Fig. 6 Typical On-Resistance vs.
Drain Current and Gate Voltage

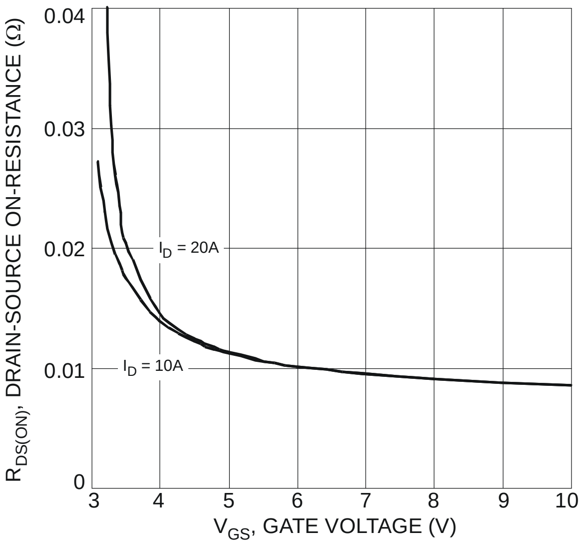


Fig. 7 Typical On-Resistance vs. Gate Voltage

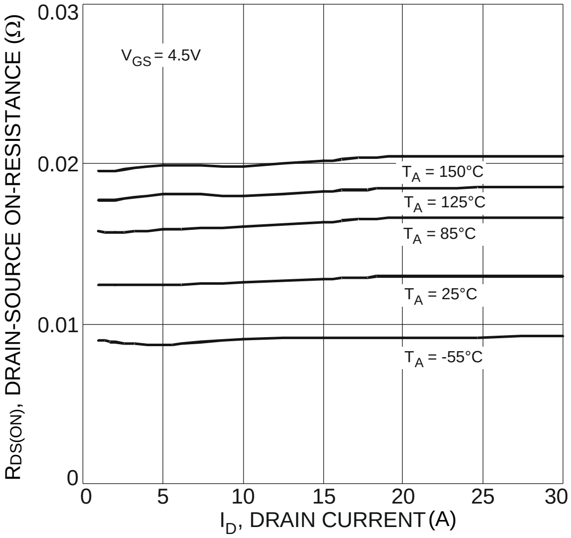


Fig. 8 Typical On-Resistance vs.
Drain Current and Temperature

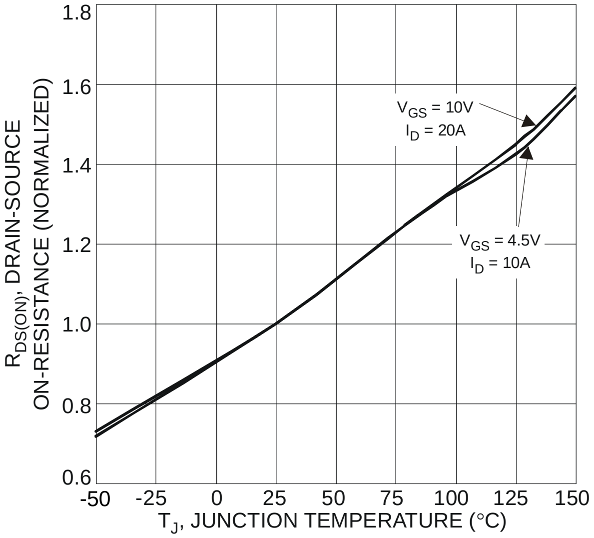


Fig. 9 On-Resistance Variation with Temperature

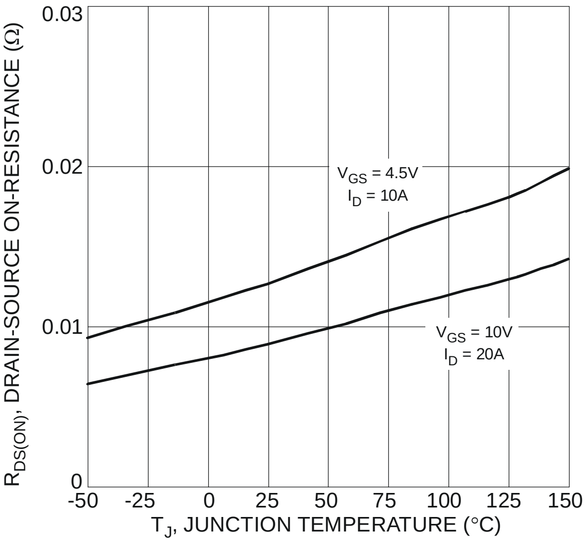


Fig. 10 On-Resistance Variation with Temperature

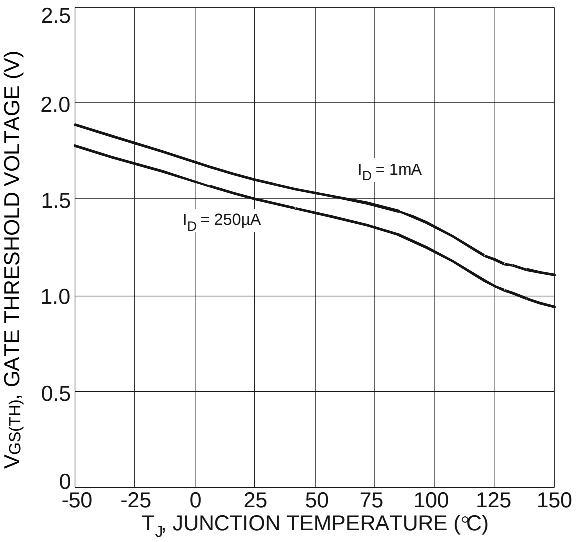


Fig. 11 Gate Threshold Variation vs. Junction Temperature

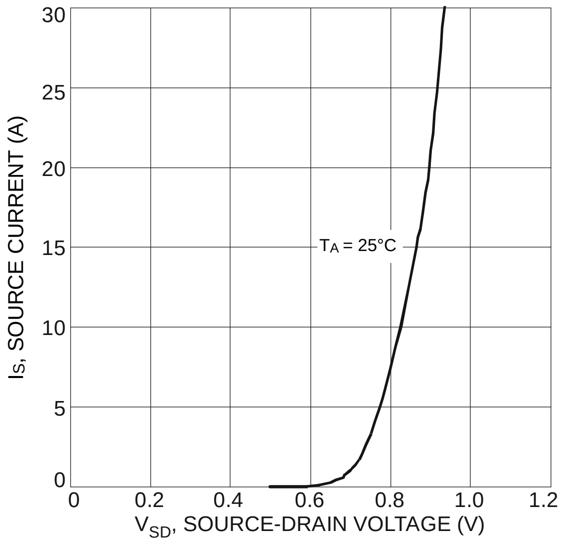


Fig.12 Diode Forward Voltage vs. Current

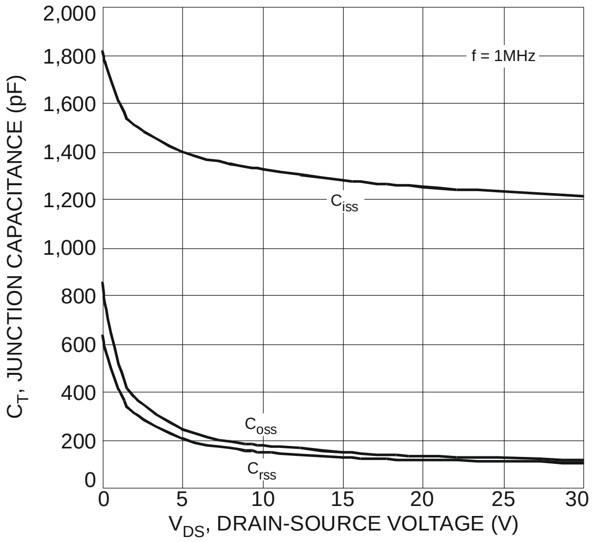


Fig. 13 Typical Junction Capacitance

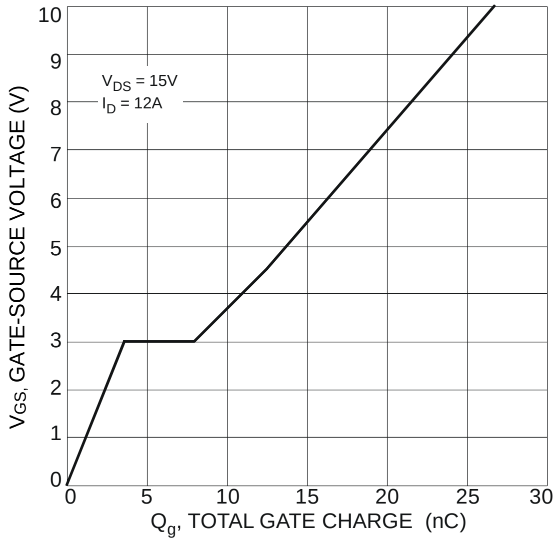
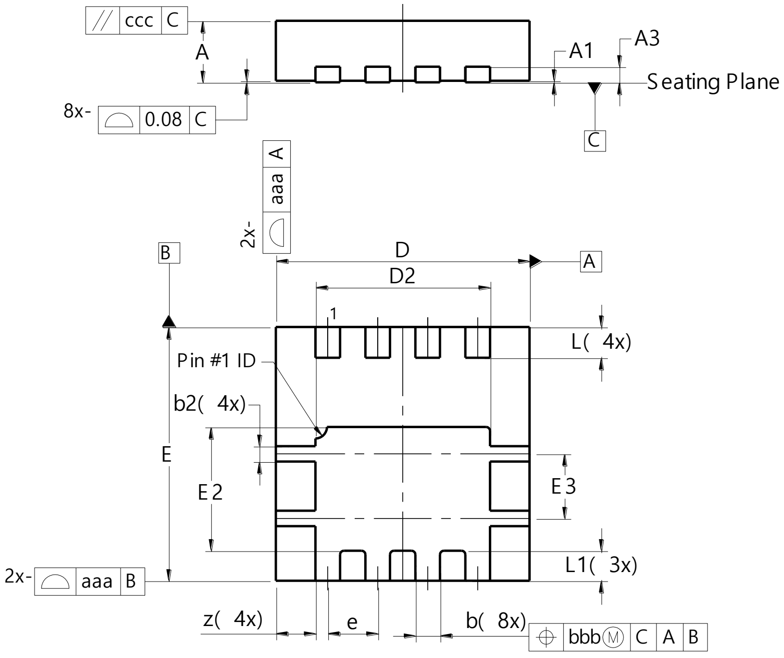


Fig. 14 Gate Charge

## Package Outline Dimensions

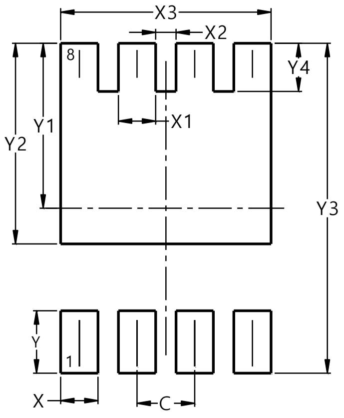
**PowerDI3333-8**



| 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** | – | – | 0.20 |
| **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 |
| **e** | – | – | 0.65 |
| **L** | 0.35 | 0.45 | 0.40 |
| **L1** | – | – | 0.39 |
| **z** | – | – | 0.515 |
| **aaa** | 0.25 | | |
| **bbb** | 0.10 | | |
| **ccc** | 0.10 | | |
| **All Dimensions in mm** | | | |

## Suggested Pad Layout

**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 |