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

| $BV_{DSS}$ | $R_{DS(ON)}$ | $I_D$<br>$T_C = +25°C$ |
|---|---|---|
| -60V | 50mΩ @ $V_{GS}$ = -10V | -26A |
| | 70mΩ @ $V_{GS}$ = -4.5V | -22A |

## Features and Benefits

- Thermally Efficient Package-Cooler Running Applications
- High Conversion Efficiency
- Low $R_{DS(ON)}$ – Minimizes On State Losses
- Low Input Capacitance
- Fast Switching Speed
- <1.1mm Package Profile – Ideal for Thin Applications

## Description and Applications

This new generation 60V P-channel enhancement mode MOSFET is designed to minimize $R_{DS(ON)}$ yet maintain superior switching performance. This device is ideal for use in notebook battery power managements and load switches.

- Notebook battery power managements
- DC-DC converters
- Load switches

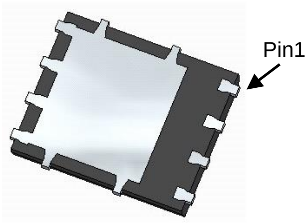
## Mechanical Data

- Package: PowerDI®5060-8
- Package Material: Molded Plastic, “Green” Molding Compound; UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminal Finish - Matte Tin Annealed over Copper Leadframe; Solderable per MIL-STD-202, Method 208 ⓔ3
- Weight: 0.097 grams (Approximate)

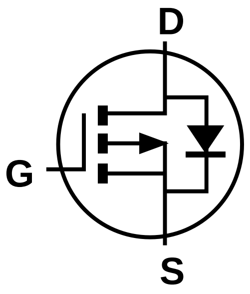
Site 1:

PowerDI5060-8

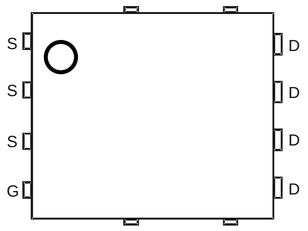
Top View



Bottom View



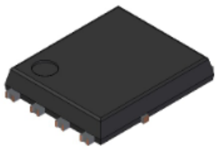
Internal Schematic



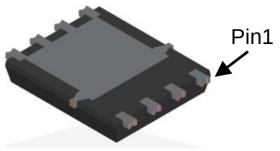
Top View
Pin Configuration

Site 2:

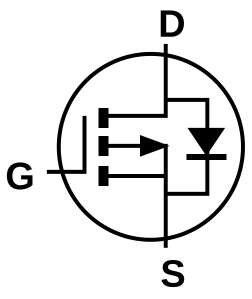
PowerDI5060-8/SWP (Type UX)



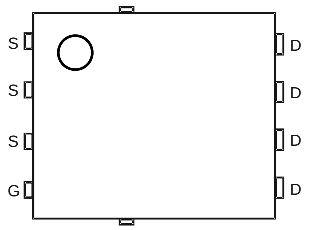
Top View



Bottom View



Internal Schematic



Top View
Pin Configuration

## 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 (Note 6) $V_{GS}$ = -10V | Steady State | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | -5.7<br>-4.5 | A |
| Pulsed Drain Current (10µs Pulse, Duty Cycle = 1%) | | | $I_{DM}$ | -45 | A |
| Maximum Continuous Body Diode Forward Current (Note 6) | | | $I_S$ | -2.4 | A |
| Pulsed Body Diode Forward Current (10µs Pulse, Duty Cycle = 1%) | | | $I_{SM}$ | -45 | A |
| Avalanche Current (Note 8) L = 0.1mH | | | $I_{AS}$ | -25 | A |
| Repetitive Avalanche Energy (Note 8) L = 0.1mH | | | $E_{AS}$ | 32 | mJ |

## Thermal Characteristics

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Power Dissipation (Note 5) | $P_D$ | 1.3 | W |
| Thermal Resistance, Junction to Ambient @ $T_A$ = +25°C (Note 5) | $R_{\theta JA}$ | 95 | °C/W |
| Power Dissipation (Note 6) | $P_D$ | 2.4 | W |
| Thermal Resistance, Junction to Ambient @ $T_A$ = +25°C (Note 6) | $R_{\theta JA}$ | 52 | °C/W |
| Thermal Resistance, Junction to Case @ $T_C$ = +25°C (Note 7) | $R_{\theta JC}$ | 2.4 | °C/W |
| 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. Thermal resistance from junction to soldering point (on the exposed drain pad).
8. $I_{AS}$ and $E_{AS}$ ratings are based on low frequency and duty cycles to keep $T_J$ = +25°C.

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

| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (Note 9)** | | | | | | |
| 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 (Note 9)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | -1.0 | — | -3.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = -250μA |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | — | 43 | 50 | mΩ | $V_{GS}$ = -10V, $I_D$ = -5A |
| | | — | 53 | 70 | | $V_{GS}$ = -4.5V, $I_D$ = -4A |
| Diode Forward Voltage | $V_{SD}$ | — | -0.7 | -1.2 | V | $V_{GS}$ = 0V, $I_S$ = -1A |
| **DYNAMIC CHARACTERISTICS (Note 10)** | | | | | | |
| Input Capacitance | $C_{iss}$ | — | 2163 | — | pF | $V_{DS}$ = -30V, $V_{GS}$ = 0V,<br>f = 1.0MHz |
| Output Capacitance | $C_{oss}$ | — | 88 | — | pF | |
| Reverse Transfer Capacitance | $C_{rss}$ | — | 58 | — | pF | |
| Gate Resistance | $R_g$ | — | 13 | — | Ω | $V_{DS}$ = 0V, $V_{GS}$ = 0V, f = 1MHz |
| Total Gate Charge ($V_{GS}$ = -10V) | $Q_g$ | — | 30 | — | nC | $V_{DS}$ = -30V, $I_D$ = -5A |
| Total Gate Charge ($V_{GS}$ = -4.5V) | $Q_g$ | — | 14 | — | nC | |
| Gate-Source Charge | $Q_{gs}$ | — | 5 | — | nC | |
| Gate-Drain Charge | $Q_{gd}$ | — | 4.6 | — | nC | |
| Turn-On Delay Time | $t_{D(ON)}$ | — | 4.7 | — | ns | $V_{GS}$ = -10V, $V_{DS}$ = -30V,<br>$R_G$ = 3Ω, $I_D$ = -5A |
| Turn-On Rise Time | $t_R$ | — | 2.7 | — | ns | |
| Turn-Off Delay Time | $t_{D(OFF)}$ | — | 73 | — | ns | |
| Turn-Off Fall Time | $t_F$ | — | 25 | — | ns | |
| Body Diode Reverse Recovery Time | $t_{RR}$ | — | 18 | — | ns | $I_F$ = -5A, di/dt = 100A/μs |
| Body Diode Reverse Recovery Charge | $Q_{RR}$ | — | 12 | — | nC | $I_F$ = -5A, di/dt = 100A/μs |

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

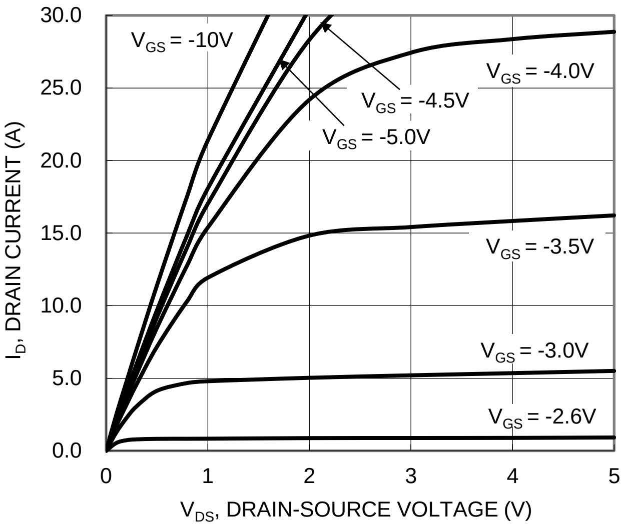


Figure 1. Typical Output Characteristic

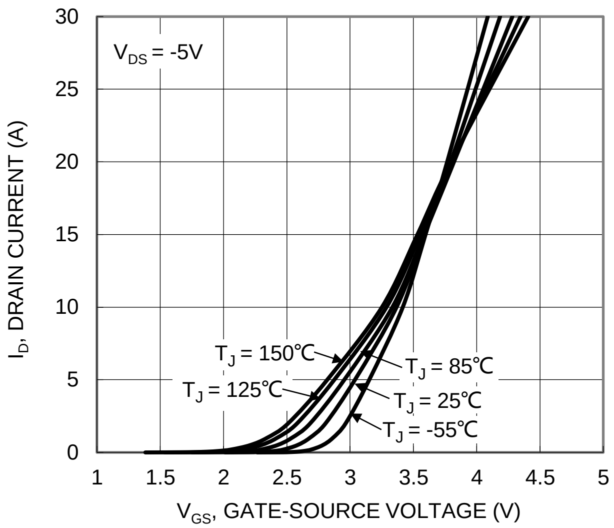


Figure 2. Typical Transfer Characteristic

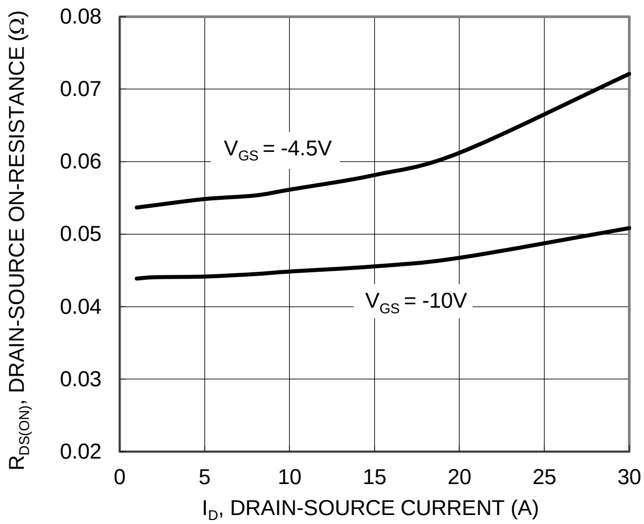


Figure 3. Typical On-Resistance vs. Drain Current and Gate Voltage

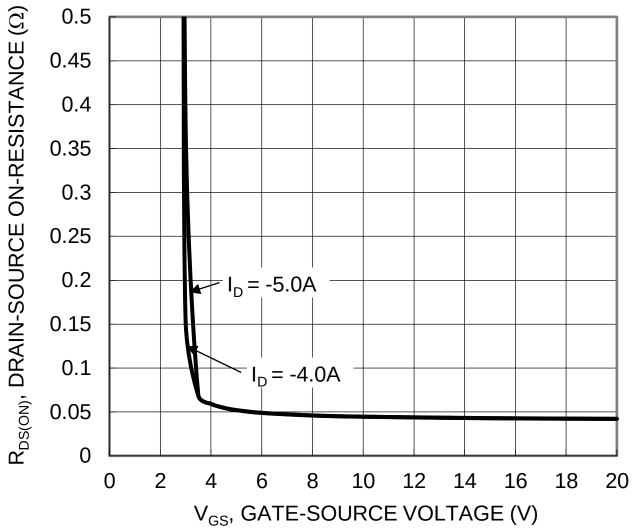


Figure 4. Typical Transfer Characteristic

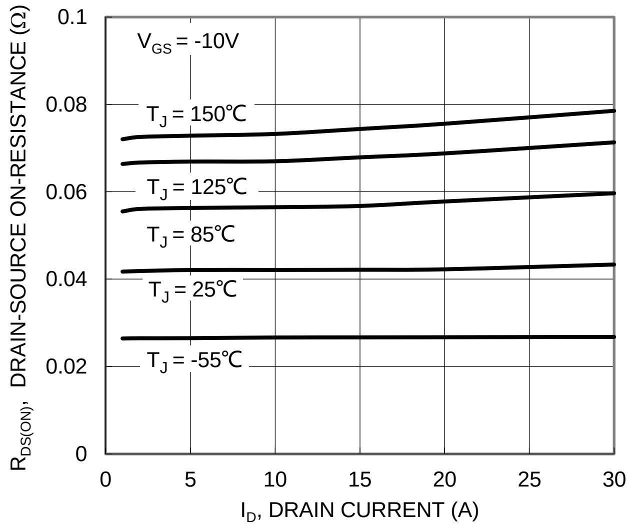


Figure 5. Typical On-Resistance vs. Drain Current and Junction Temperature

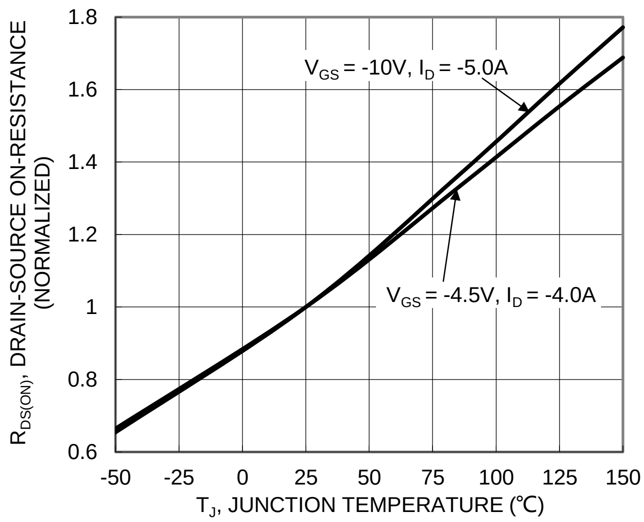


Figure 6. On-Resistance Variation with Junction Temperature

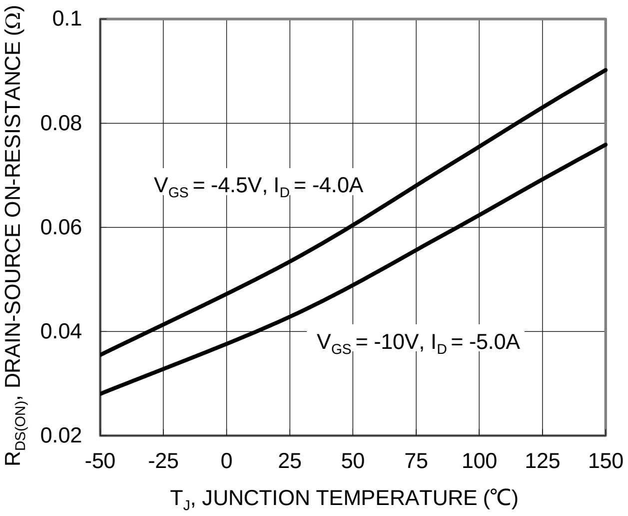


Figure 7. On-Resistance Variation with Junction Temperature

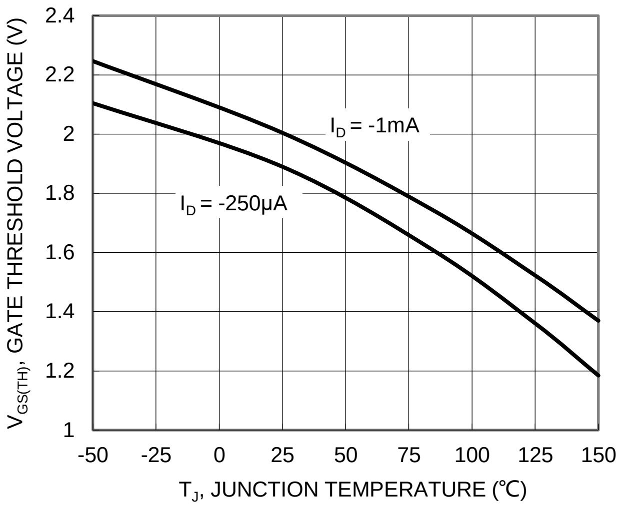


Figure 8. Gate Threshold Variation vs. Junction Temperature

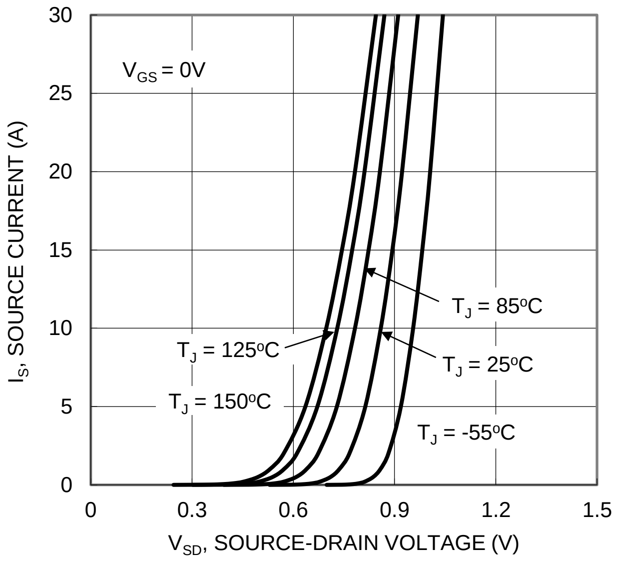


Figure 9. Diode Forward Voltage vs. Current

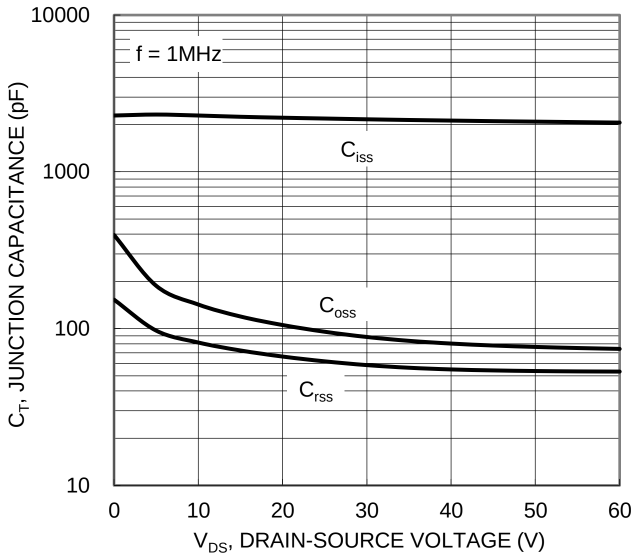


Figure 10.Typical Junction Capacitance

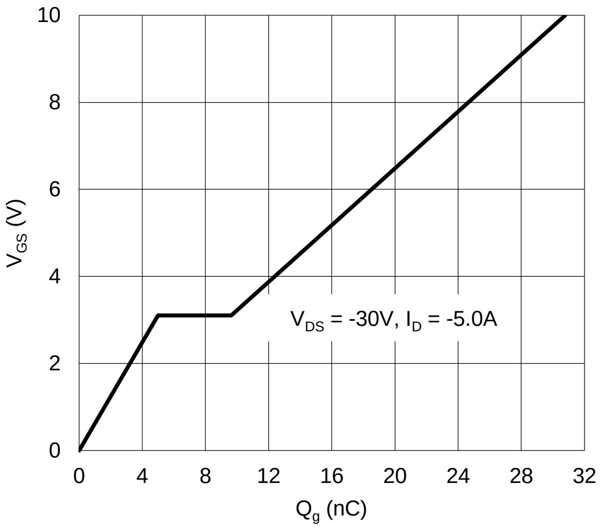


Figure 11. Gate Charge

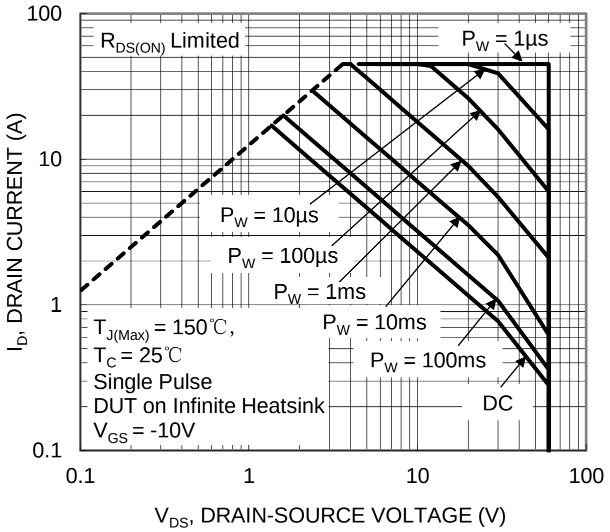


Figure 12. SOA, Safe Operation Area

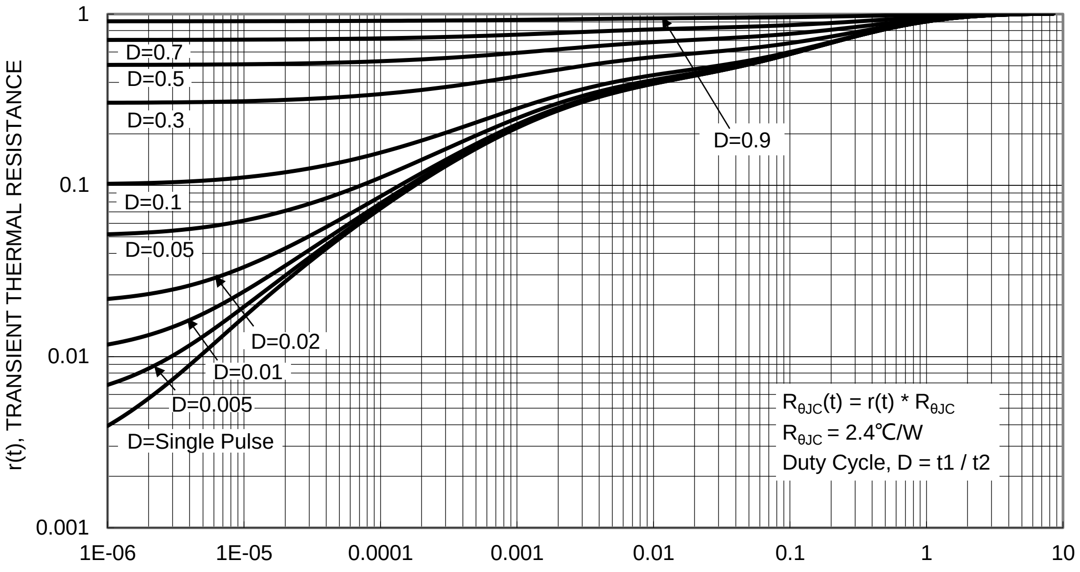
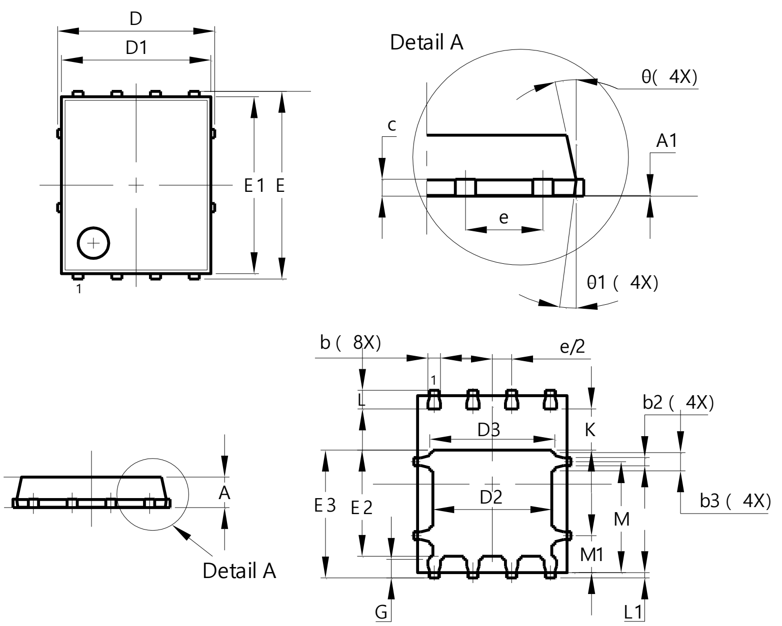


Figure 13. Transient Thermal Resistance

## Package Outline Dimensions

**Site 1:**

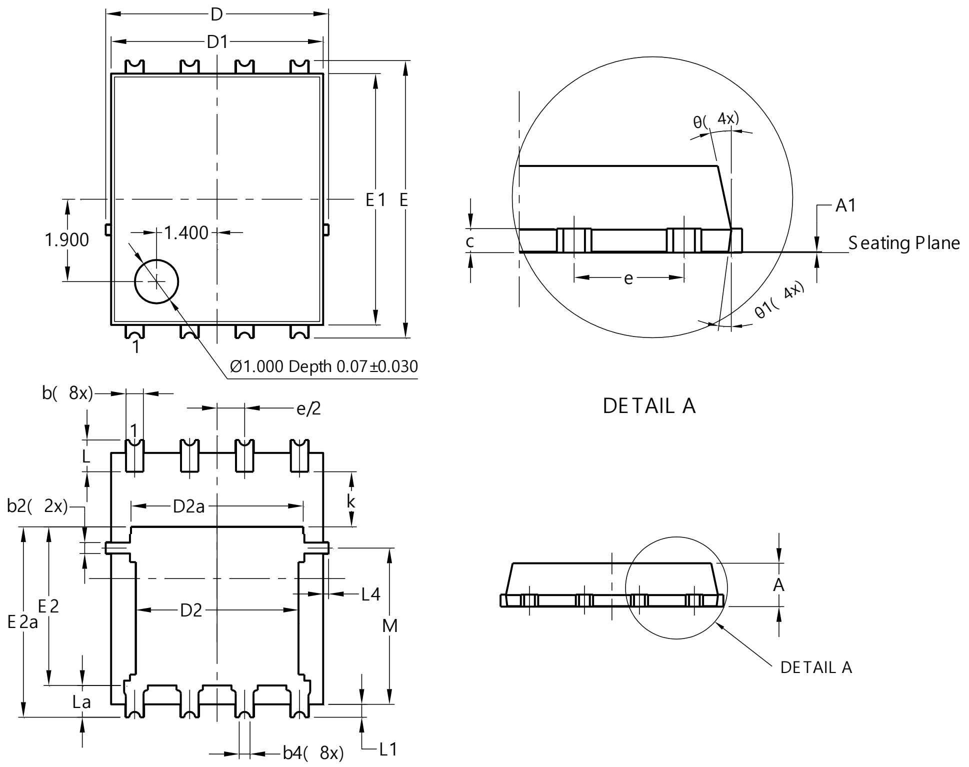
**PowerDI5060-8**



| PowerDI5060-8 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 0.90 | 1.10 | 1.00 |
| **A1** | 0.00 | 0.05 | – |
| **b** | 0.33 | 0.51 | 0.41 |
| **b2** | 0.200 | 0.350 | 0.273 |
| **b3** | 0.40 | 0.80 | 0.60 |
| **c** | 0.230 | 0.330 | 0.277 |
| **D** | 5.15 BSC | | |
| **D1** | 4.70 | 5.10 | 4.90 |
| **D2** | 3.70 | 4.10 | 3.90 |
| **D3** | 3.90 | 4.30 | 4.10 |
| **E** | 6.15 BSC | | |
| **E1** | 5.60 | 6.00 | 5.80 |
| **E2** | 3.28 | 3.68 | 3.48 |
| **E3** | 3.99 | 4.39 | 4.19 |
| **e** | 1.27 BSC | | |
| **G** | 0.51 | 0.71 | 0.61 |
| **K** | 0.51 | – | – |
| **L** | 0.51 | 0.71 | 0.61 |
| **L1** | 0.100 | 0.200 | 0.175 |
| **M** | 3.235 | 4.035 | 3.635 |
| **M1** | 1.00 | 1.40 | 1.21 |
| **Θ** | 10° | 12° | 11° |
| **Θ1** | 6° | 8° | 7° |
| **All Dimensions in mm** | | | |

**Site 2:**

**PowerDI5060-8/SWP (Type UX)**

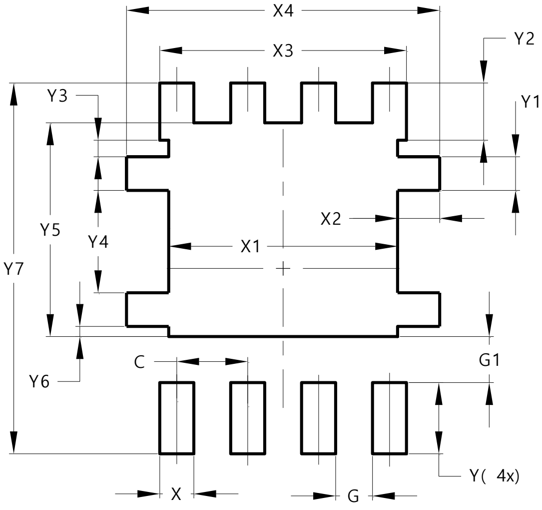


| PowerDI5060-8/SWP (Type UX) | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 0.90 | 1.10 | 1.00 |
| **A1** | 0 | 0.05 | -- |
| **b** | 0.30 | 0.50 | 0.41 |
| **b2** | 0.20 | 0.35 | 0.25 |
| **b4** | 0.25REF | | |
| **c** | 0.230 | 0.330 | 0.277 |
| **D** | 5.15 BSC | | |
| **D1** | 4.70 | 5.10 | 4.90 |
| **D2** | 3.56 | 3.96 | 3.76 |
| **D2a** | 3.78 | 4.18 | 3.98 |
| **E** | 6.40 BSC | | |
| **E1** | 5.60 | 6.00 | 5.80 |
| **E2** | 3.46 | 3.86 | 3.66 |
| **E2a** | 4.195 | 4.595 | 4.395 |
| **e** | 1.27BSC | | |
| **k** | 1.05 | -- | -- |
| **L** | 0.635 | 0.835 | 0.735 |
| **La** | 0.635 | 0.835 | 0.735 |
| **L1** | 0.200 | 0.400 | 0.300 |
| **L1a** | 0.050REF | | |
| **L4** | 0.025 | 0.225 | 0.125 |
| **M** | 3.205 | 4.005 | 3.605 |
| **θ** | 10° | 12° | 11° |
| **θ1** | 6° | 8° | 7° |
| **All Dimensions in mm** | | | |

## Suggested Pad Layout

**Site 1:**

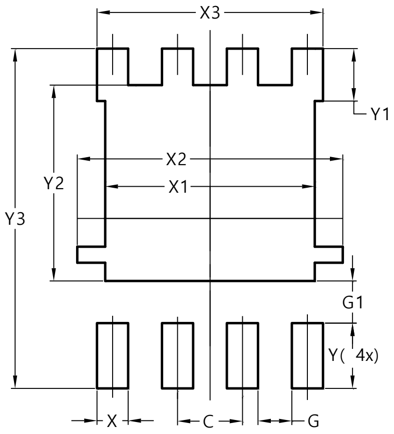
**PowerDI5060-8**



| Dimensions | Value (in mm) |
|---|---|
| C | 1.270 |
| G | 0.660 |
| G1 | 0.820 |
| X | 0.610 |
| X1 | 4.100 |
| X2 | 0.755 |
| X3 | 4.420 |
| X4 | 5.610 |
| Y | 1.270 |
| Y1 | 0.600 |
| Y2 | 1.020 |
| Y3 | 0.295 |
| Y4 | 1.825 |
| Y5 | 3.810 |
| Y6 | 0.180 |
| Y7 | 6.610 |

**Site 2:**

**PowerDI5060-8/SWP (Type UX)**



| Dimensions | Value (in mm) |
|---|---|
| C | 1.270 |
| G | 0.660 |
| G1 | 0.820 |
| X | 0.610 |
| X1 | 4.100 |
| X2 | 5.190 |
| X3 | 4.420 |
| Y | 1.270 |
| Y1 | 1.020 |
| Y2 | 3.810 |
| Y3 | 6.610 |