# 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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企业微信二维码　　　企业QQ二维码

## Product Summary

| BV$_{DSS}$ | R$_{DS(ON)\ MAX}$ | I$_D$ T$_C$ = +25°C |
|---|---|---|
| -40V | 5.2mΩ @ V$_{GS}$ = -10V | -115A |
| | 7.9mΩ @ V$_{GS}$ = -6V | -94A |

## Features and Benefits

- 100% Unclamped Inductive Switch (UIS) Test in Production
- Low On-Resistance
- Fast Switching Speed
- Wettable Flank for Improved Optical Inspections

## Description and Applications

This new generation 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.

- Reverse Polarity Protection
- BLDC Motor Control
- Power Management Functions
- System/Load Switch

## Mechanical Data

- Case: PowerDI®5060-8
- Case 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
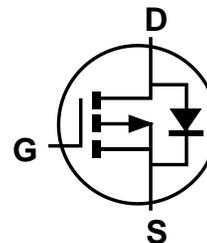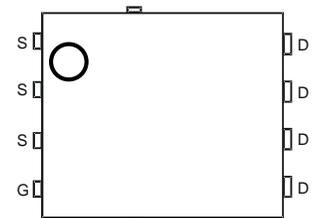- Weight: 0.097 grams (Approximate)

PowerDI5060-8 (SWP) (Type UX)
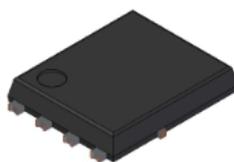


Top View

Bottom View

Pin1
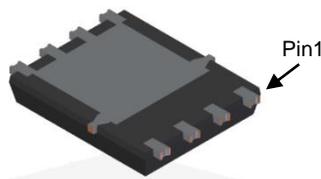
Internal Schematic

Top View
Pin Configuration

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

| Characteristic | | | Symbol | Value | Unit |
|---|---|---|---|---|---|
| Drain-Source Voltage | | | $V_{DSS}$ | -40 | V |
| Gate-Source Voltage | | | $V_{GSS}$ | ±20 | V |
| Continuous Drain Current (Note 6) $V_{GS}$ = -10V | Steady State | $T_C$ = +25°C $T_C$ = +70°C | $I_D$ | -115 -92 | A |
| Pulsed Drain Current (10μs Pulse, Duty Cycle = 1%) | | | $I_{DM}$ | -460 | A |
| Maximum Body Diode Continuous Current | | | $I_S$ | -115 | A |
| Pulsed Source Current (10μs Pulse, Duty Cycle = 1%) | | | $I_{SM}$ | -460 | A |
| Avalanche Current (L =0.1mH) | | | $I_{AS}$ | -72 | A |
| Avalanche Energy (L = 0.1mH) | | | $E_{AS}$ | 262 | mJ |

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

| Characteristic | | Symbol | Value | Unit |
|---|---|---|---|---|
| Total Power Dissipation (Note 5) | $T_A$ = +25°C Steady State | $P_D$ | 3.4 | W |
| Thermal Resistance, Junction to Ambient (Note 5) | | $R_{θJA}$ | 36.5 | °C/W |
| Total Power Dissipation (Note 6) | $T_C$ = +25°C | $P_D$ | 104 | W |
| Thermal Resistance, Junction to Case (Note 6) | | $R_{θJC}$ | 1.2 | °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 thermal bias to bottom layer 1inch square copper plate.
             6. Thermal resistance from junction to soldering point (on the exposed drain pad).

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## 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 | $BV_{DSS}$ | -40 | — | — | V | $V_{GS}$ = 0V, $I_D$ = -250µA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | — | — | -1 | µA | $V_{DS}$ = -40V, $V_{GS}$ = 0V |
| Gate-Source Leakage | $I_{GSS}$ | — | — | ±100 | nA | $V_{GS}$ = ±20V, $V_{DS}$ = 0V |
| **ON CHARACTERISTICS (Note 7)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | -2.0 | — | -3.0 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = -250µA |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | — | 3.6 | 5.2 | mΩ | $V_{GS}$ = -10V, $I_D$ = -9.8A |
| | | — | 4.5 | 7.9 | | $V_{GS}$ = -6V, $I_D$ = -9.8A |
| Diode Forward Voltage | $V_{SD}$ | — | -0.7 | -1 | V | $V_{GS}$ = 0V, $I_S$ = -1A |
| **DYNAMIC CHARACTERISTICS (Note 8)** | | | | | | |
| Input Capacitance | $C_{iss}$ | — | 6855 | — | pF | $V_{DS}$ = -20V, $V_{GS}$ = 0V<br>f = 1MHz |
| Output Capacitance | $C_{oss}$ | — | 883 | — | | |
| Reverse Transfer Capacitance | $C_{rss}$ | — | 526 | — | | |
| Gate Resistance | $R_g$ | — | 7.8 | — | Ω | $V_{DS}$ = 0V, $V_{GS}$ = 0V, f = 1MHz |
| Total Gate Charge ($V_{GS}$ = -10V) | $Q_g$ | — | 162 | — | nC | $V_{DS}$ = -20V, $I_D$ = -9.8A |
| Gate-Source Charge | $Q_{gs}$ | — | 28 | — | | |
| Gate-Drain Charge | $Q_{gd}$ | — | 38 | — | | |
| Turn-On Delay Time | $t_{D(ON)}$ | — | 28 | — | ns | $V_{GS}$ = -10V, $V_{DD}$ = -20V,<br>$R_G$ = 6Ω, $I_D$ = -9.8A |
| Turn-On Rise Time | $t_R$ | — | 32 | — | | |
| Turn-Off Delay Time | $t_{D(OFF)}$ | — | 469 | — | | |
| Turn-Off Fall Time | $t_F$ | — | 228 | — | | |
| Reverse Recovery Time | $t_{RR}$ | — | 44 | — | ns | $I_F$ = -9.8A, di/dt = -100A/µs |
| Reverse Recovery Charge | $Q_{RR}$ | — | 48 | — | nC | $I_F$ = -9.8A, di/dt = -100A/µs |

Notes:     7. Short duration pulse test used to minimize self-heating effect.
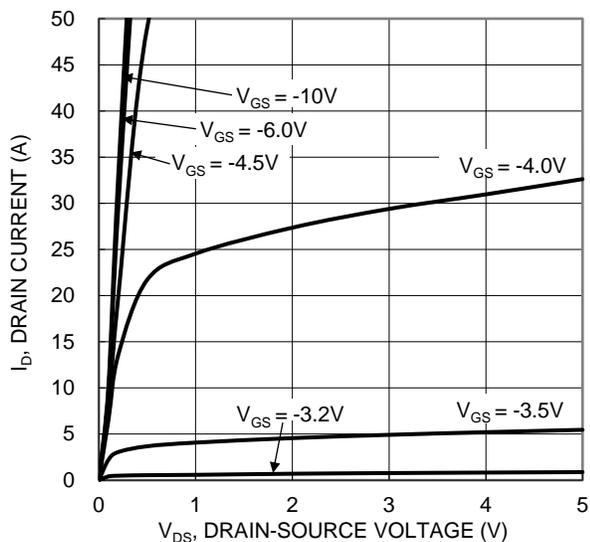              8. Guaranteed by design. Not subject to product testing.
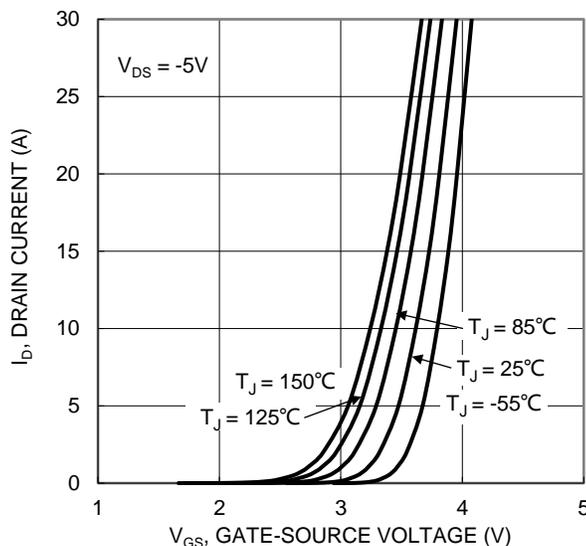
Figure 1. Typical Output Characteristic


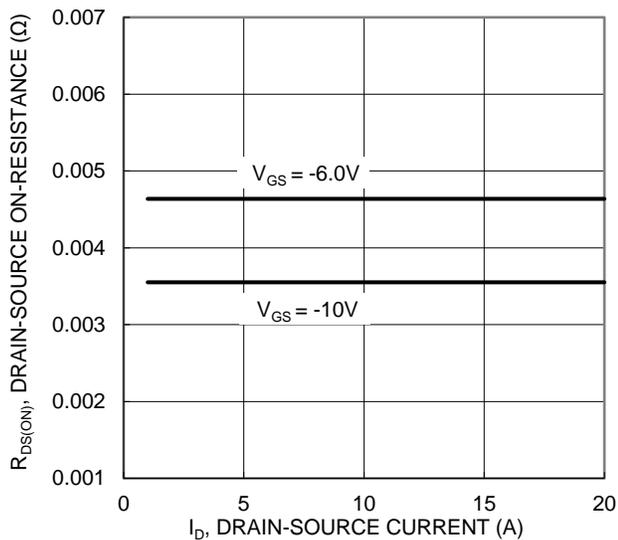Figure 2. Typical Transfer Characteristic


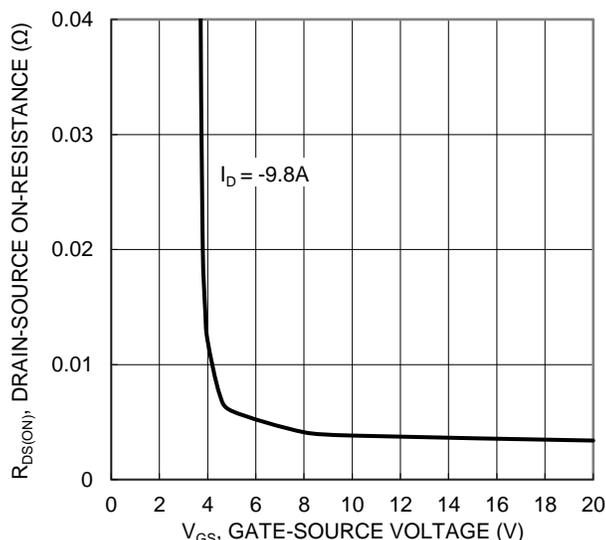Figure 3. Typical On-Resistance vs. Drain Current and Gate Voltage


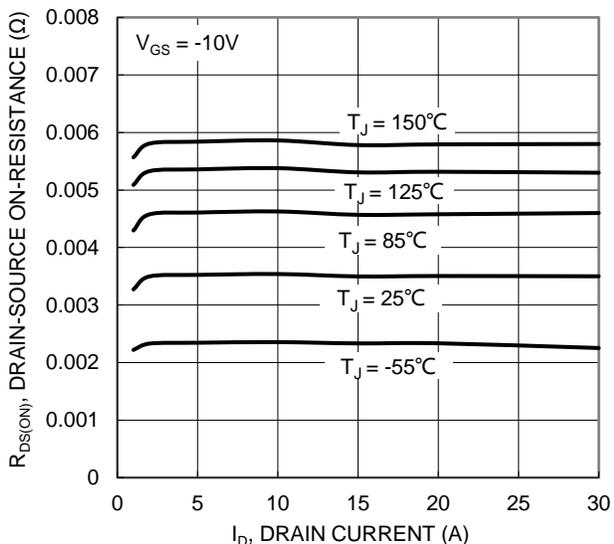Figure 4. Typical Transfer Characteristic


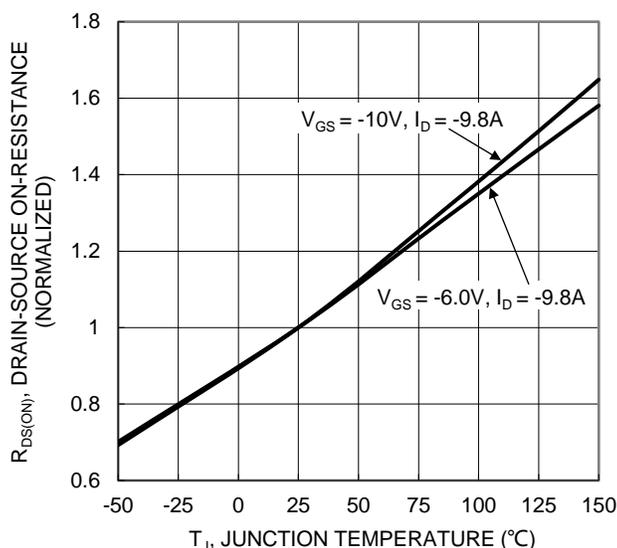Figure 5. Typical On-Resistance vs. Drain Current and Junction Temperature


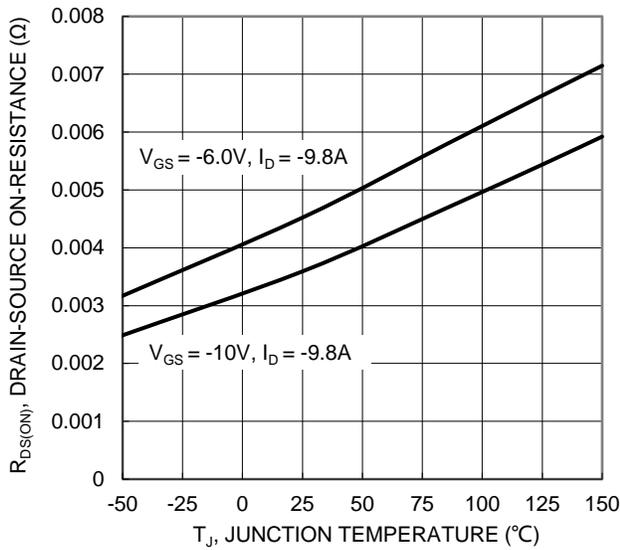Figure 6. On-Resistance Variation with Junction Temperature

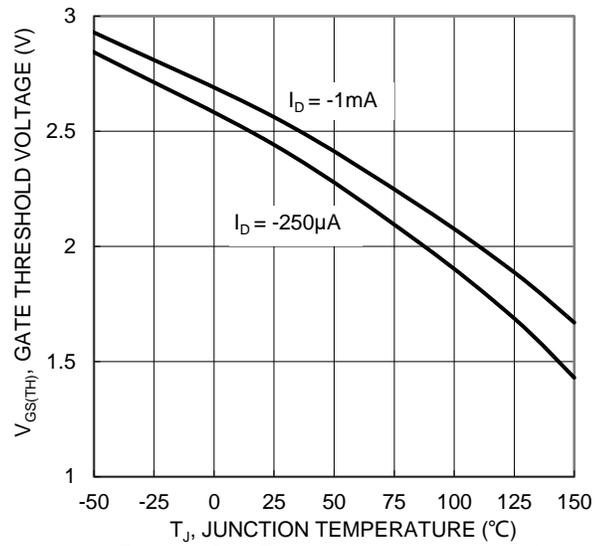Figure 7. On-Resistance Variation with Junction Temperature



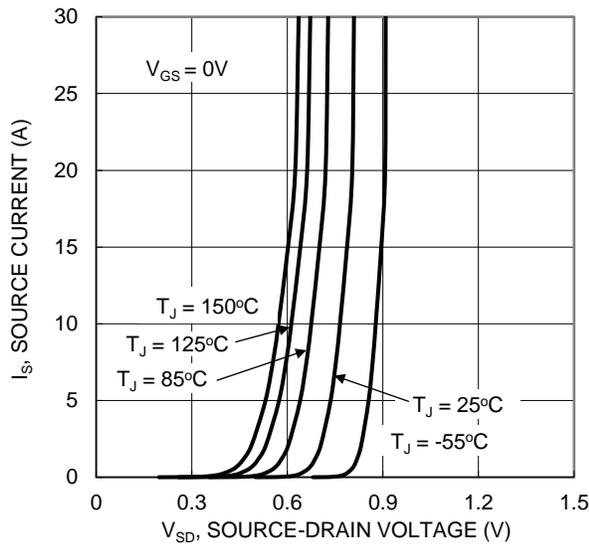Figure 8. Gate Threshold Variation vs. Junction Temperature



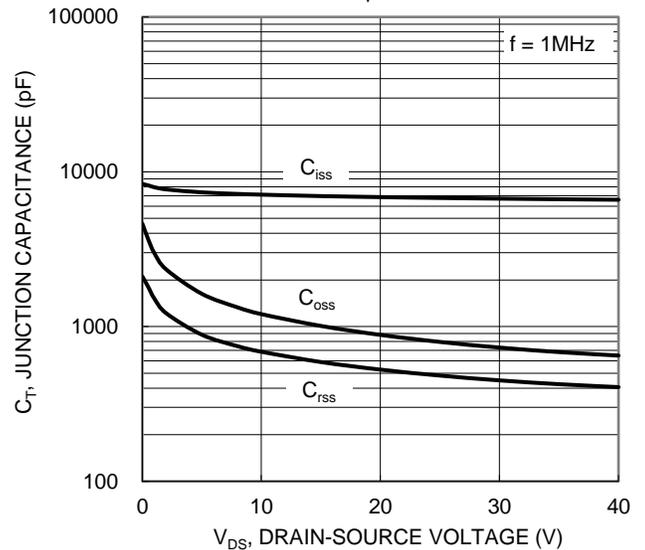Figure 9. Diode Forward Voltage vs. Current
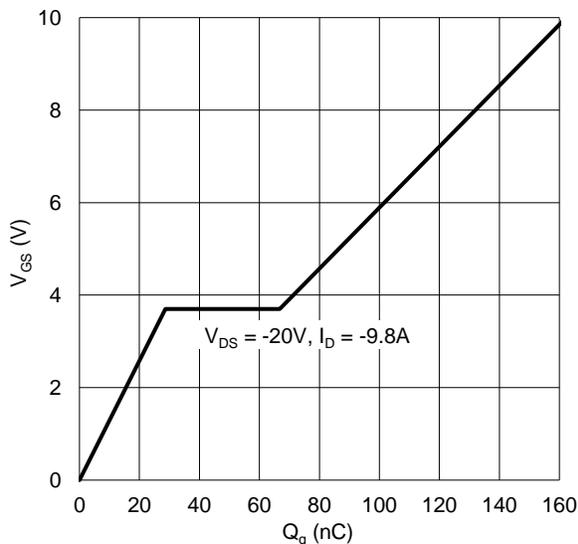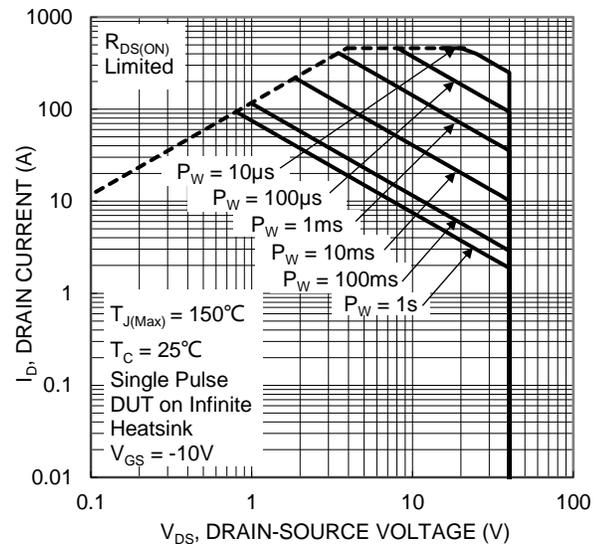


Figure 10. Typical Junction Capacitance



Figure 11. Gate Charge



Figure 12. SOA, Safe Operation Area
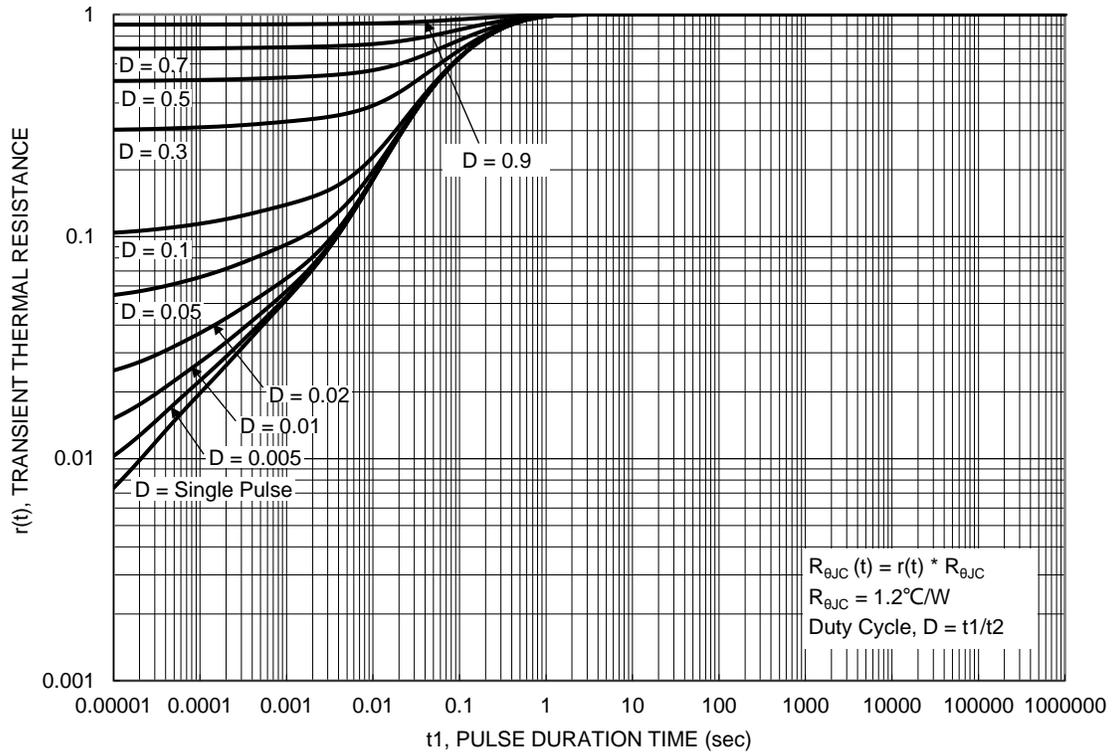
Figure 13. Transient Thermal Resistance

The chart shows r(t), TRANSIENT THERMAL RESISTANCE versus t1, PULSE DURATION TIME (sec) with curves labeled:
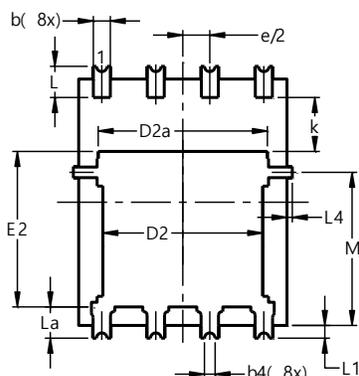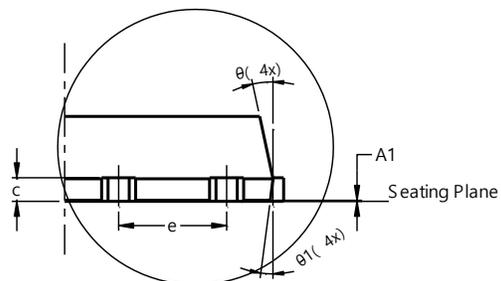- D = 0.9
- D = 0.7
- D = 0.5
- D = 0.3
- D = 0.1
- D = 0.05
- D = 0.02
- D = 0.01
- D = 0.005
- D = Single Pulse

$R_{\theta JC}(t) = r(t) * R_{\theta JC}$
$R_{\theta JC} = 1.2°C/W$
Duty Cycle, $D = t1/t2$

## Package Outline Dimensions

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



DETAIL A

Seating Plane

Ø1.000 Depth 0.07±0.030
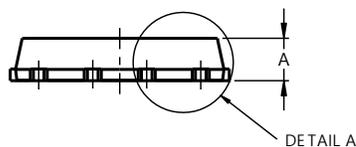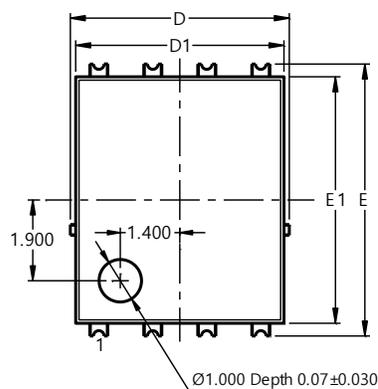
| PowerDI5060-8 (SWP) (Type UX) | | | |
|---|---|---|---|
| Dim | Min | Max | Typ |
| A | 0.90 | 1.10 | 1.00 |
| A1 | 0 | 0.05 | -- |
| b | 0.30 | 0.50 | 0.41 |
| b2 | 0.20 | 0.35 | 0.25 |
| b4 | 0.25REF | | |
| c | 0.230 | 0.330 | 0.277 |
| D | 5.15 BSC | | |
| D1 | 4.70 | 5.10 | 4.90 |
| D2 | 3.56 | 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

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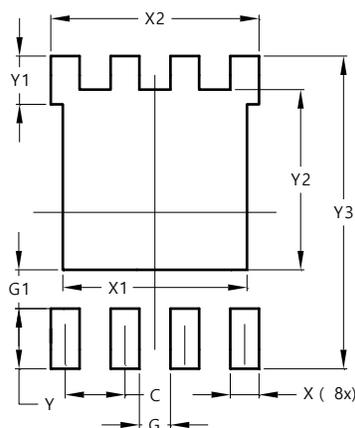


| Dimensions | Value (in mm) |
|---|---|
| C | 1.270 |
| G | 0.660 |
| G1 | 0.820 |
| X | 0.610 |
| X1 | 4.100 |
| X2 | 4.420 |
| Y | 1.270 |
| Y1 | 1.020 |
| Y2 | 3.810 |
| Y3 | 6.610 |