# 60V 175°C DUAL N-CHANNEL ENHANCEMENT MODE MOSFET
## PowerDI5060-8

## Product Summary

| $BV_{DSS}$ | $R_{DS(ON)}$ Max | $I_D$ Max $T_C$ = +25°C |
|---|---|---|
| 60V | 25mΩ @ $V_{GS}$ = 10V | 32A |
| | 40mΩ @ $V_{GS}$ = 4.5V | 25A |

## Features and Benefits

- Rated to +175°C—Ideal for High Ambient Temperature Environments
- 100% Unclamped Inductive Switching—Ensures More Reliable and Robust End Application
- High Conversion Efficiency
- Low $R_{DS(ON)}$—Minimizes On-State Losses
- Low Input Capacitance
- Fast Switching Speed
- Wettable Flank for Improved Optical Inspection
- **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

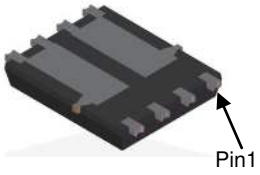
This MOSFET is designed to meet the stringent requirements of Automotive applications. It is qualified to AEC-Q101, supported by a PPAP, and is ideal for use in:

- Backlighting
- Power Management Functions
- DC-DC Converters

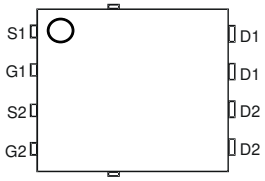
## Mechanical Data

- Case: PowerDI®5060-8
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 3 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: 0.097 grams (Approximate)

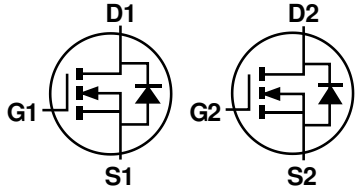
Top View




Bottom View




Pin Out
Top View



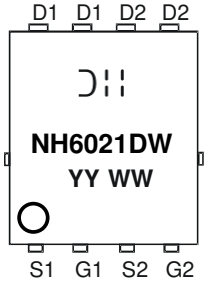

Equivalent Circuit

## Ordering Information (Note 5)

| Part Number | Case | Packaging |
|---|---|---|
| DMNH6021SPDWQ-13 | PowerDI5060-8 (SWP) (Type R) | 2500/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 http://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




= Manufacturer's Marking
NH6021DW = Product Type Marking Code
YYWW = Date Code Marking
YY = Year (ex: 19 = 2019)
WW = Week (01 to 53)

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

| Characteristic | | Symbol | Value | Unit |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DSS}$ | 60 | V |
| Gate-Source Voltage | | $V_{GSS}$ | ±20 | V |
| Continuous Drain Current (Note 7) $V_{GS}$ = 10V | $T_A$ = +25°C<br>$T_A$ = +70°C | $I_D$ | 8.2<br>6.5 | A |
| Continuous Drain Current (Note 8) $V_{GS}$ = 10V | $T_C$ = +25°C<br>$T_C$ = +100°C | $I_D$ | 32<br>22 | A |
| Pulsed Drain Current (380µs Pulse, Duty Cycle = 1%) | | $I_{DM}$ | 80 | A |
| Maximum Continuous Body Diode Forward Current (Note 7) | | $I_S$ | 32 | A |
| Avalanche Current, L = 0.1mH (Note 9) | | $I_{AS}$ | 35 | A |
| Avalanche Energy, L = 0.1mH (Note 9) | | $E_{AS}$ | 64 | mJ |

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

| Characteristic | | Symbol | Value | Unit |
|---|---|---|---|---|
| Total Power Dissipation (Note 6) | | $P_D$ | 1.5 | W |
| Thermal Resistance, Junction to Ambient (Note 6) | Steady State | $R_{\Theta JA}$ | 99 | °C/W |
| | t<10s | | 53 | |
| Total Power Dissipation (Note 7) | | $P_D$ | 2.8 | W |
| Thermal Resistance, Junction to Ambient (Note 7) | Steady State | $R_{\Theta JA}$ | 54 | °C/W |
| | t<10s | | 27 | |
| Thermal Resistance, Junction to Case (Note 8) | | $R_{\Theta JC}$ | 2.2 | °C/W |
| Operating and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to +175 | °C |

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

| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** (Note 10) | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | 60 | — | — | V | $V_{GS}$ = 0V, $I_D$ = 250µA |
| Zero Gate Voltage Drain Current $T_J$ = +25°C | $I_{DSS}$ | — | — | 1 | µA | $V_{DS}$ = 60V, $V_{GS}$ = 0V |
| Gate-Source Leakage | $I_{GSS}$ | — | — | ±100 | nA | $V_{GS}$ = ±20V, $V_{DS}$ = 0V |
| **ON CHARACTERISTICS** (Note 10) | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | 1 | — | 3 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 250µA |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | — | 15 | 25 | mΩ | $V_{GS}$ = 10V, $I_D$ = 15A |
| | | — | 21 | 40 | | $V_{GS}$ = 4.5V, $I_D$ = 12A |
| Diode Forward Voltage | $V_{SD}$ | — | 0.75 | 1.2 | V | $V_{GS}$ = 0V, $I_S$ = 2.6A |
| **DYNAMIC CHARACTERISTICS** (Note 11) | | | | | | |
| Input Capacitance | $C_{iss}$ | — | 1,143 | — | pF | $V_{DS}$ = 25V, $V_{GS}$ = 0V, f = 1MHz |
| Output Capacitance | $C_{oss}$ | — | 168 | — | pF | |
| Reverse Transfer Capacitance | $C_{rss}$ | — | 69 | — | pF | |
| Gate Resistance | $R_g$ | — | 2.5 | — | Ω | $V_{DS}$ = 0V, $V_{GS}$ = 0V, f = 1MHz |
| Total Gate Charge ($V_{GS}$ = 10V) | $Q_g$ | — | 20.1 | — | nC | $V_{DS}$ = 30V, $I_D$ = 20A, |
| Total Gate Charge ($V_{GS}$ = 6V) | $Q_g$ | — | 12 | — | nC | |
| Gate-Source Charge | $Q_{gs}$ | — | 4.3 | — | nC | |
| Gate-Drain Charge | $Q_{gd}$ | — | 5.5 | — | nC | |
| Turn-On Delay Time | $t_{D(ON)}$ | — | 4.4 | — | ns | $V_{DD}$ = 30V, $V_{GS}$ = 10V, $R_g$ = 4.7Ω, $I_D$ = 20A |
| Turn-On Rise Time | $t_R$ | — | 6.0 | — | ns | |
| Turn-Off Delay Time | $t_{D(OFF)}$ | — | 14.2 | — | ns | |
| Turn-Off Fall Time | $t_F$ | — | 5.4 | — | ns | |
| Body Diode Reverse Recovery Time | $t_{RR}$ | — | 21.2 | — | ns | $I_F$=20A, di/dt=100A/µs |
| Body Diode Reverse Recovery Charge | $Q_{RR}$ | — | 15.2 | — | nC | |

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.
8. Thermal resistance from junction to soldering point (on the exposed drain pad).
9. $I_{AS}$ and $E_{AS}$ ratings are based on low frequency and duty cycles to keep $T_J$ = +25°C.
10. Short duration pulse test used to minimize self-heating effect.
11. Guaranteed by design. Not subject to product testing.


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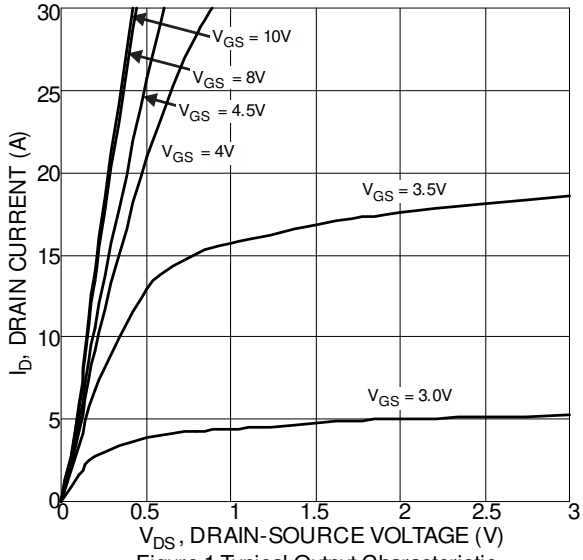


Figure 1 Typical Output Characteristic

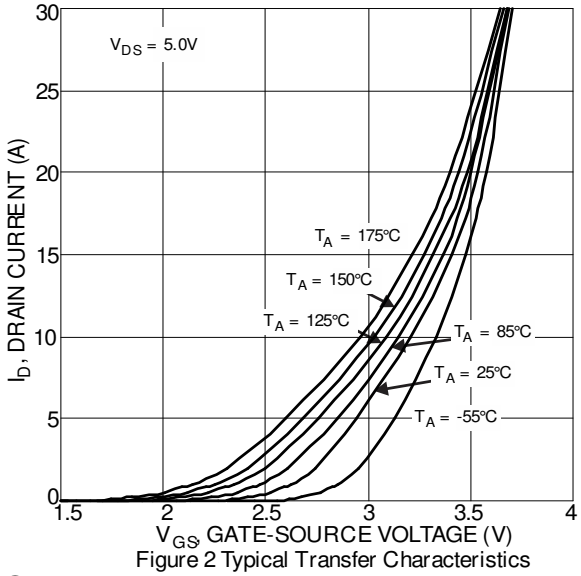


Figure 2 Typical Transfer Characteristics

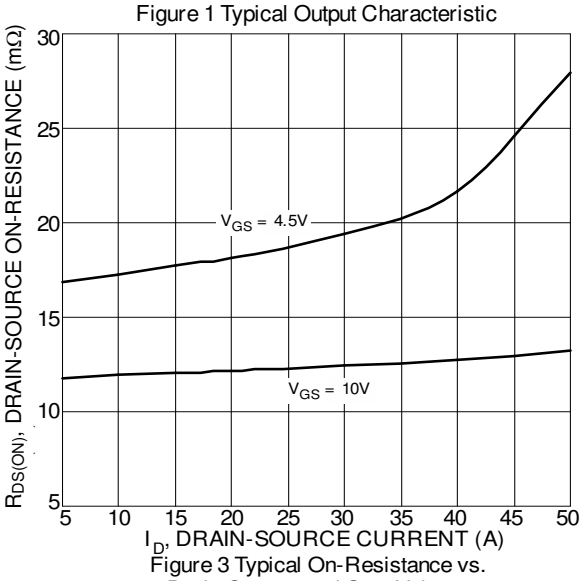


Figure 3 Typical On-Resistance vs. Drain Current and Gate Voltage

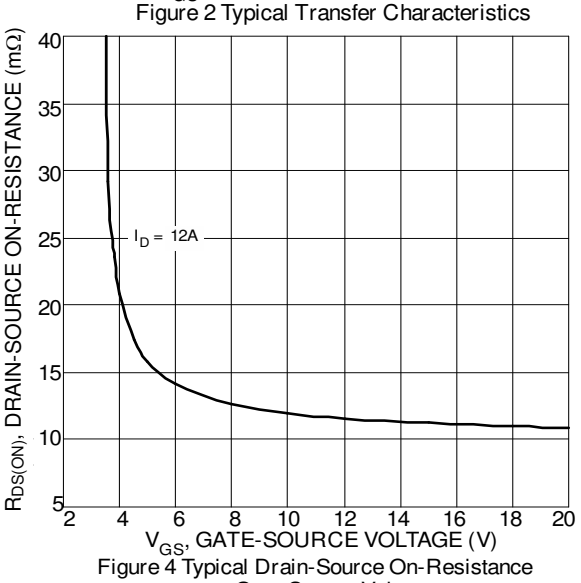


Figure 4 Typical Drain-Source On-Resistance vs. Gate-Source Voltage

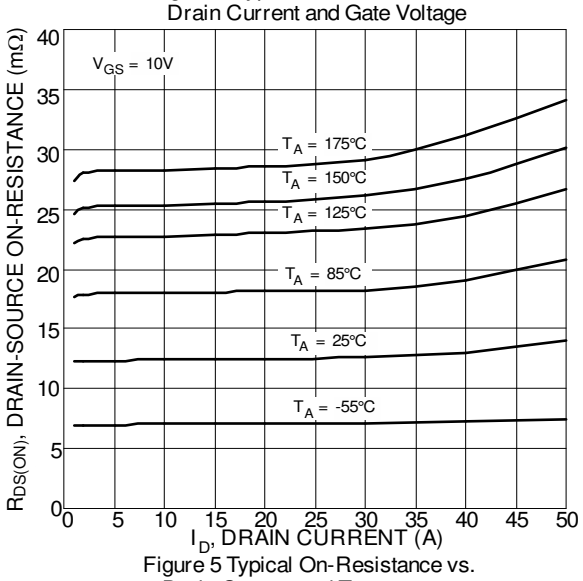


Figure 5 Typical On-Resistance vs. Drain Current and Temperature

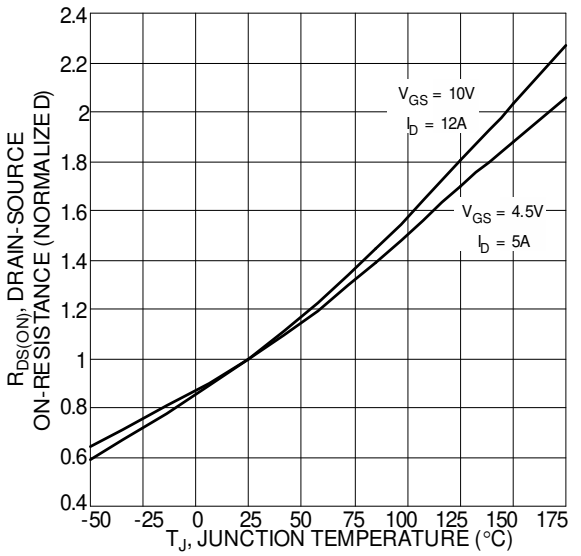


Figure 6 On-Resistance Variation with Temperature


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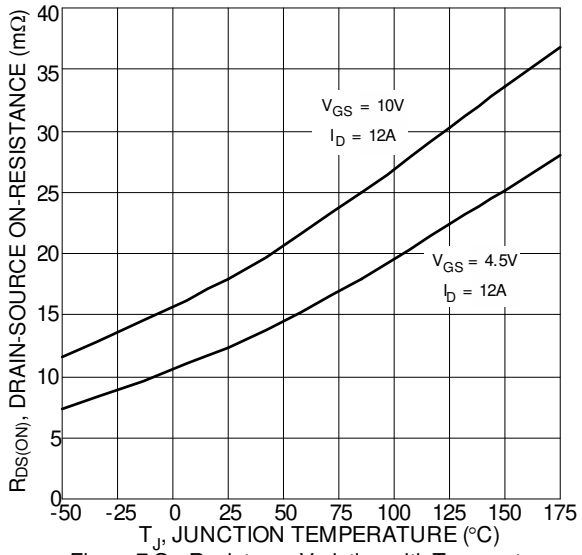

Figure 7 On-Resistance Variation with Temperature

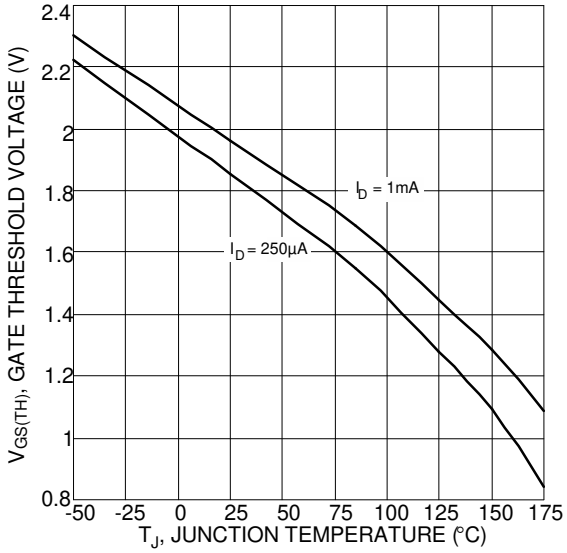

Figure 8 Gate Threshold Variation vs. Junction Temperature

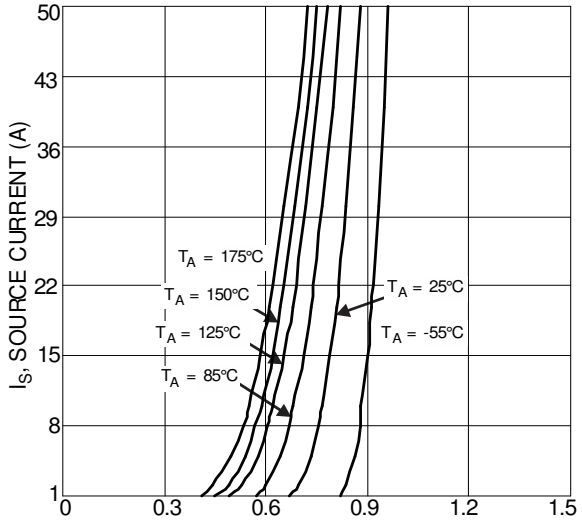

Figure 9 Diode Forward Voltage vs. Current

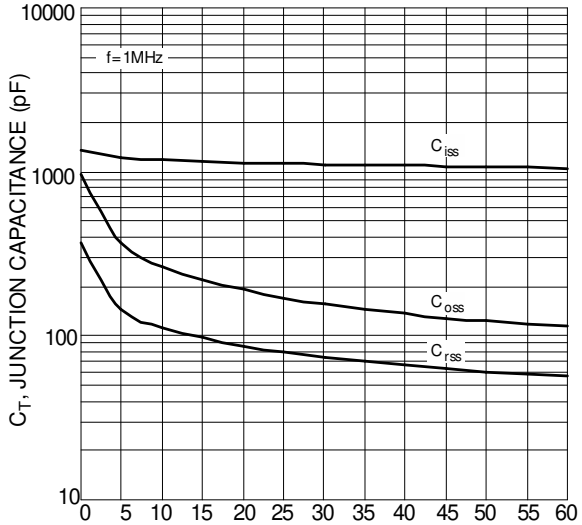

Figure 10 Typical Junction Capacitance

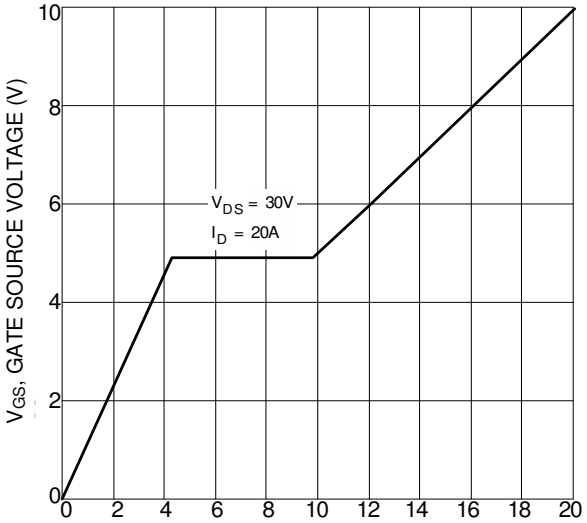

Figure 11 Gate Charge

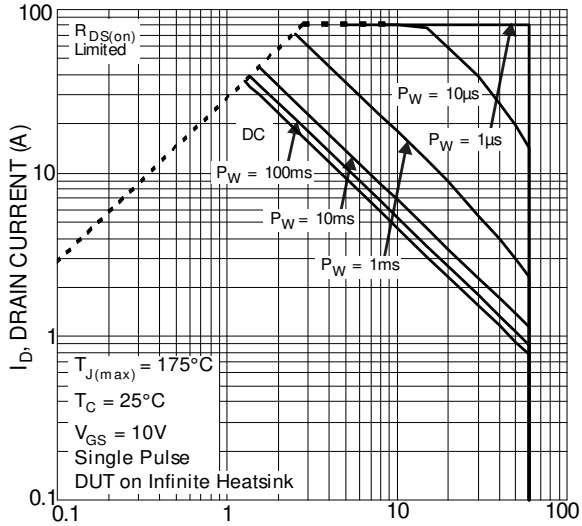

Figure 12 SOA, Safe Operation Area


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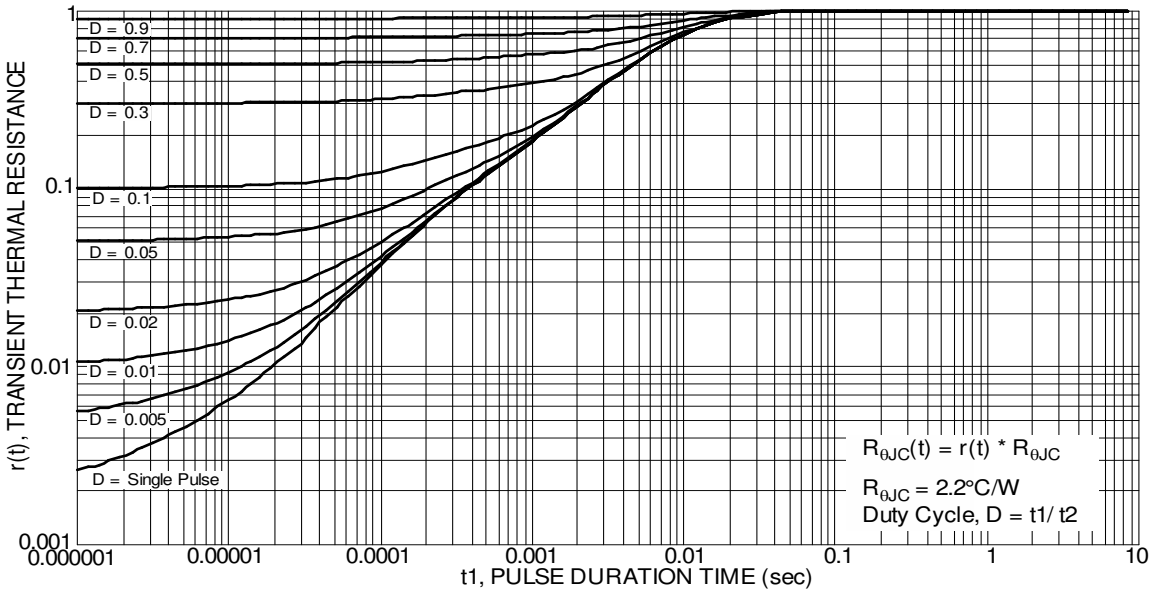


Figure 13 Transient Thermal Resistance


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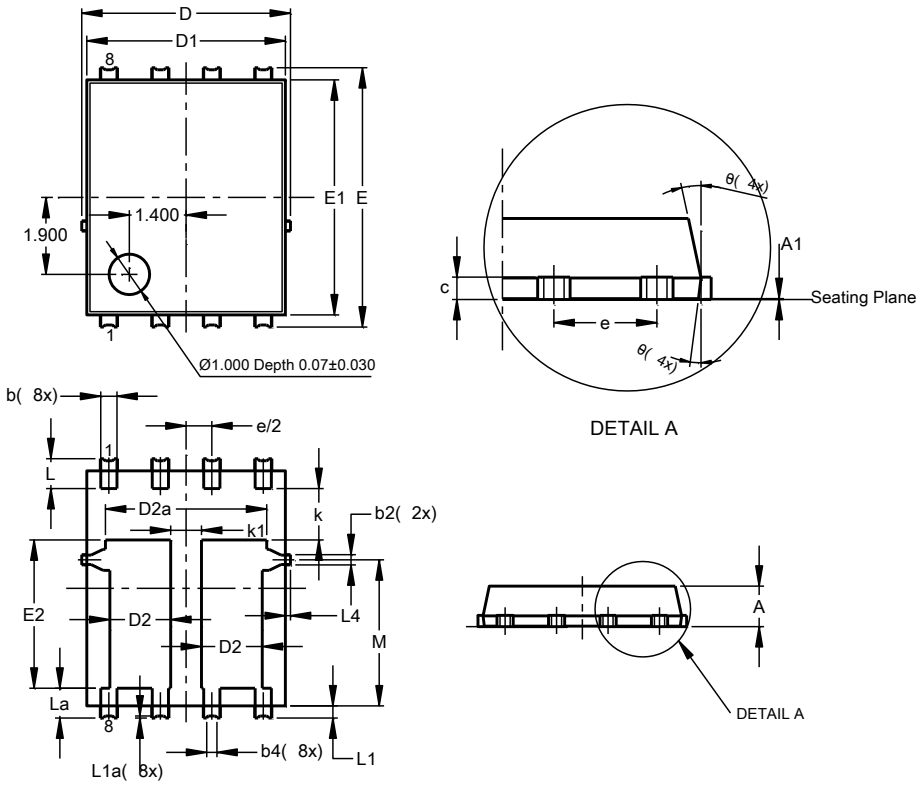
## Package Outline Dimensions

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

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

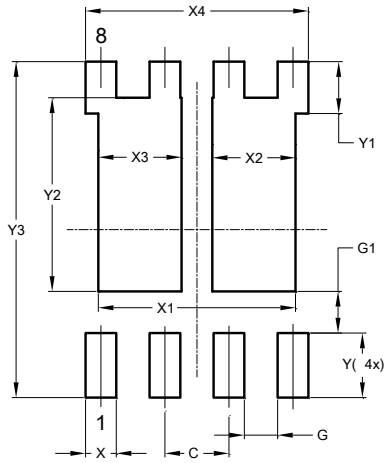



| PowerDI5060-8 (SWP) (Type R) | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 0.90 | 1.10 | 1.00 |
| **A1** | 0 | 0.05 | -- |
| **b** | 0.30 | 0.50 | 0.41 |
| **b2** | 0.20 | 0.35 | 0.25 |
| **b4** | 0.25REF | | |
| **c** | 0.230 | 0.330 | 0.277 |
| **D** | 5.15 BSC | | |
| **D1** | 4.70 | 5.10 | 4.90 |
| **D2** | 1.40 | 1.60 | 1.50 |
| **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 |
| **e** | 1.27BSC | | |
| **k** | 1.05 | -- | -- |
| **k1** | 0.56 | -- | -- |
| **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

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

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




| Dimensions | Value (in mm) |
|---|---|
| **C** | 1.270 |
| **G** | 0.660 |
| **G1** | 0.820 |
| **X** | 0.610 |
| **X1** | 3.910 |
| **X2** | 1.650 |
| **X3** | 1.650 |
| **X4** | 4.420 |
| **Y** | 1.270 |
| **Y1** | 1.020 |
| **Y2** | 3.810 |
| **Y3** | 6.610 |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