

## Product Summary

| BV <sub>DSS</sub> | R <sub>DS(ON)</sub>           | I <sub>D</sub><br>T <sub>C</sub> = +25°C<br>(Note 5) |
|-------------------|-------------------------------|------------------------------------------------------|
| 40V               | 6.0mΩ @ V <sub>GS</sub> = 10V | 100A                                                 |

## Features

- Rated to +175°C – Ideal for High Ambient Temperature Environments
- 100% Unclamped Inductive Switch (UIS) Test in Production
- Low R<sub>DS(ON)</sub> – Minimizes Power Losses
- Low Q<sub>g</sub> – Minimizes Switching Losses
- < 1.1mm Package Profile – Ideal for Thin Applications
- Lead-Free Finish; RoHS Compliant (Notes 1 & 2)**
- Halogen and Antimony Free. “Green” Device (Note 3)**
- For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please [contact us](https://www.diodes.com/quality/product-definitions/) or your local Diodes representative.

## Description and Applications

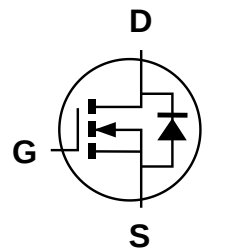
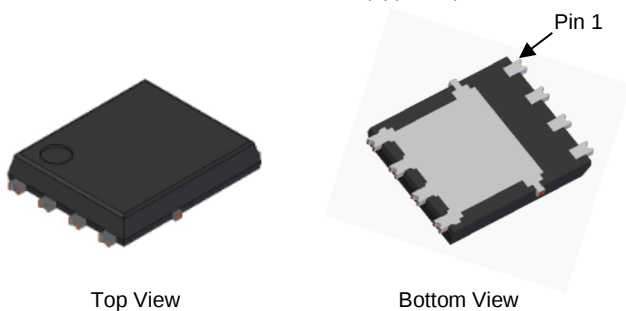
This MOSFET has been designed to minimize the on-state resistance (R<sub>DS(ON)</sub>) yet maintain superior switching performance, making it ideal for high-efficiency power-management applications.

- Engine-management systems
- Body control electronics
- DC-DC converters

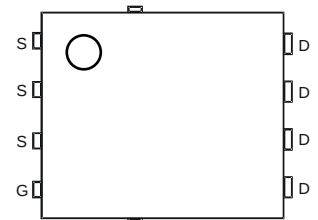
## Mechanical Data

- Package: PowerDI<sup>®</sup>5060-8
- Package Material: Molded Plastic, “Green” Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Annealed over Copper Leadframe. Solderable per MIL-STD-202, Method 208 (B3)
- Weight: 0.097 grams (Approximate)

PowerDI5060-8/SWP (Type UX)



Internal Schematic



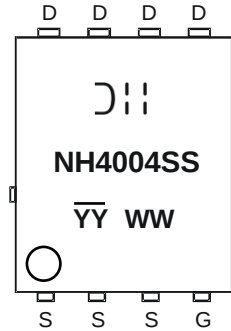
Top View  
Pin Configuration

## Ordering Information (Note 4)

| Orderable Part Number | Package                     | Packing |         |
|-----------------------|-----------------------------|---------|---------|
|                       |                             | Qty.    | Carrier |
| DMNH4004SPSW-13       | PowerDI5060-8/SWP (Type UX) | 2,500   | Reel    |

- Notes:
- EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant. All applicable RoHS exemptions applied.
  - 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.
  - Halogen- and Antimony-free “Green” products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
  - For packaging details, go to our website at <https://www.diodes.com/design/support/packaging/diodes-packaging/>.
  - Limited by package.

## Marking Information



𐄀𐄀𐄀 = Manufacturer's Marking  
 NH4004SS = Product Type Marking Code  
 YYWW = Date Code Marking  
 YY = Last Two Digits of Year (ex: 24 = 2024)  
 WW = Week Code (01 to 53)

## Maximum Ratings (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic                                               |              |                                                   | Symbol           | Value     | Unit |
|--------------------------------------------------------------|--------------|---------------------------------------------------|------------------|-----------|------|
| Drain-Source Voltage                                         |              |                                                   | V <sub>DSS</sub> | 40        | V    |
| Gate-Source Voltage                                          |              |                                                   | V <sub>GSS</sub> | 20        | V    |
| Continuous Drain Current (Notes 5 & 6) V <sub>GS</sub> = 10V | Steady State | T <sub>C</sub> = +25°C<br>T <sub>C</sub> = +100°C | I <sub>D</sub>   | 100<br>83 | A    |
| Pulsed Drain Current (10μs Pulse, Duty Cycle = 1%)           |              |                                                   | I <sub>DM</sub>  | 400       | A    |
| Maximum Continuous Body Diode Forward Current                |              |                                                   | I <sub>S</sub>   | 117       | A    |
| Pulsed Source Current (10μs Pulse, Duty Cycle = 1%)          |              |                                                   | I <sub>SM</sub>  | 400       | A    |
| Avalanche Current (Note 7) L = 1mH                           |              |                                                   | I <sub>AS</sub>  | 27        | A    |
| Avalanche Energy (Note 7) L = 1mH                            |              |                                                   | E <sub>AS</sub>  | 536       | mJ   |

## Thermal Characteristics

| Characteristic                                   |              |  | Symbol                            | Value       | Unit |
|--------------------------------------------------|--------------|--|-----------------------------------|-------------|------|
| Total Power Dissipation (Note 8)                 |              |  | P <sub>D</sub>                    | 1.6         | W    |
| Thermal Resistance, Junction to Ambient (Note 8) | Steady State |  | R <sub>θJA</sub>                  | 96          | °C/W |
| Total Power Dissipation (Note 6)                 |              |  | P <sub>D</sub>                    | 2.8         | W    |
| Thermal Resistance, Junction to Ambient (Note 6) | Steady State |  | R <sub>θJA</sub>                  | 53          | °C/W |
| Thermal Resistance, Junction to Case (Note 9)    |              |  | R <sub>θJC</sub>                  | 1.2         |      |
| Operating and Storage Temperature Range          |              |  | T <sub>J</sub> , T <sub>STG</sub> | -55 to +175 | °C   |

Notes: 5. Limited by package.  
 6. Device mounted on FR-4 substrate PC board, 2oz copper, with thermal bias to bottom layer 1inch square copper plate.  
 7. I<sub>AS</sub> and E<sub>AS</sub> ratings are based on low frequency and duty cycles to keep T<sub>J</sub> = +25°C.  
 8. Device mounted on FR-4 PC board, with minimum recommended pad layout, single sided.  
 9. Thermal resistance from junction to soldering point (on the exposed drain pad).

**Electrical Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic                                          | Symbol              | Min | Typ  | Max  | Unit | Test Condition                                                                              |
|---------------------------------------------------------|---------------------|-----|------|------|------|---------------------------------------------------------------------------------------------|
| <b>OFF CHARACTERISTICS (Note 10)</b>                    |                     |     |      |      |      |                                                                                             |
| Drain-Source Breakdown Voltage                          | B <sub>V</sub> DSS  | 40  | —    | —    | V    | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA                                                |
| Zero Gate Voltage Drain Current, T <sub>J</sub> = +25°C | I <sub>DSS</sub>    | —   | —    | 1    | μA   | V <sub>DS</sub> = 32V, V <sub>GS</sub> = 0V                                                 |
| Gate-Source Leakage                                     | I <sub>GSS</sub>    | —   | —    | ±100 | nA   | V <sub>GS</sub> = ±20V, V <sub>DS</sub> = 0V                                                |
| <b>ON CHARACTERISTICS (Note 10)</b>                     |                     |     |      |      |      |                                                                                             |
| Gate Threshold Voltage                                  | V <sub>GS(TH)</sub> | 2   | 2.5  | 3.5  | V    | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                                  |
| Static Drain-Source On-Resistance                       | R <sub>DS(ON)</sub> | —   | 3.3  | 6    | mΩ   | V <sub>GS</sub> = 10V, I <sub>D</sub> = 50A                                                 |
| Diode Forward Voltage                                   | V <sub>SD</sub>     | —   | 0.7  | 1.2  | V    | V <sub>GS</sub> = 0V, I <sub>S</sub> = 1.0A                                                 |
| <b>DYNAMIC CHARACTERISTICS (Note 11)</b>                |                     |     |      |      |      |                                                                                             |
| Input Capacitance                                       | C <sub>iss</sub>    | —   | 2284 | —    | pF   | V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V<br>f = 1MHz                                     |
| Output Capacitance                                      | C <sub>oss</sub>    | —   | 532  | —    | pF   |                                                                                             |
| Reverse Transfer Capacitance                            | C <sub>rss</sub>    | —   | 171  | —    | pF   |                                                                                             |
| Gate Resistance                                         | R <sub>g</sub>      | —   | 1.98 | —    | Ω    | V <sub>DS</sub> = 0V, V <sub>GS</sub> = 0V, f = 1MHz                                        |
| Total Gate Charge (V <sub>GS</sub> = 10V)               | Q <sub>g</sub>      | —   | 40   | —    | nC   | V <sub>DS</sub> = 32V, I <sub>D</sub> = 86A                                                 |
| Gate-Source Charge                                      | Q <sub>gs</sub>     | —   | 8.5  | —    | nC   |                                                                                             |
| Gate-Drain Charge                                       | Q <sub>gd</sub>     | —   | 11.4 | —    | nC   |                                                                                             |
| Turn-On Delay Time                                      | t <sub>D(ON)</sub>  | —   | 6.3  | —    | ns   | V <sub>GS</sub> = 10V, V <sub>DS</sub> = 20V<br>R <sub>g</sub> = 3.5Ω, I <sub>D</sub> = 86A |
| Turn-On Rise Time                                       | t <sub>r</sub>      | —   | 5.4  | —    | ns   |                                                                                             |
| Turn-Off Delay Time                                     | t <sub>D(OFF)</sub> | —   | 20.5 | —    | ns   |                                                                                             |
| Turn-Off Fall Time                                      | t <sub>f</sub>      | —   | 9.0  | —    | ns   | I <sub>F</sub> = 50A, di/dt = 100A/μs                                                       |
| Body Diode Reverse-Recovery Time                        | t <sub>RR</sub>     | —   | 35.8 | —    | ns   |                                                                                             |
| Body Diode Reverse-Recovery Charge                      | Q <sub>RR</sub>     | —   | 34.7 | —    | nC   | I <sub>F</sub> = 50A, di/dt = 100A/μs                                                       |

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

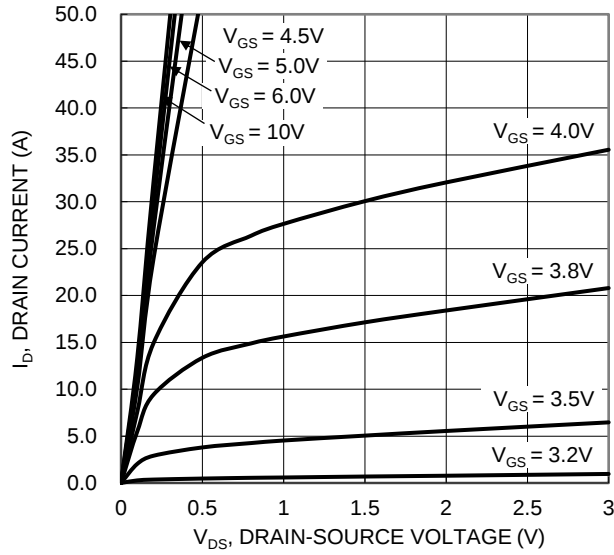


Figure 1. Typical Output Characteristic

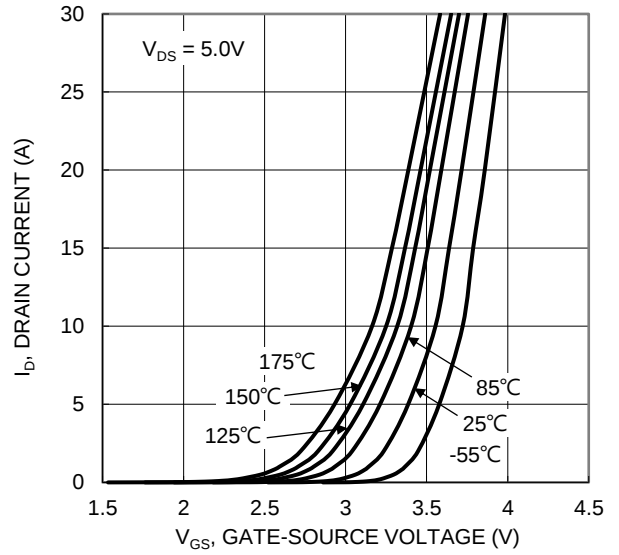


Figure 2. Typical Transfer Characteristic

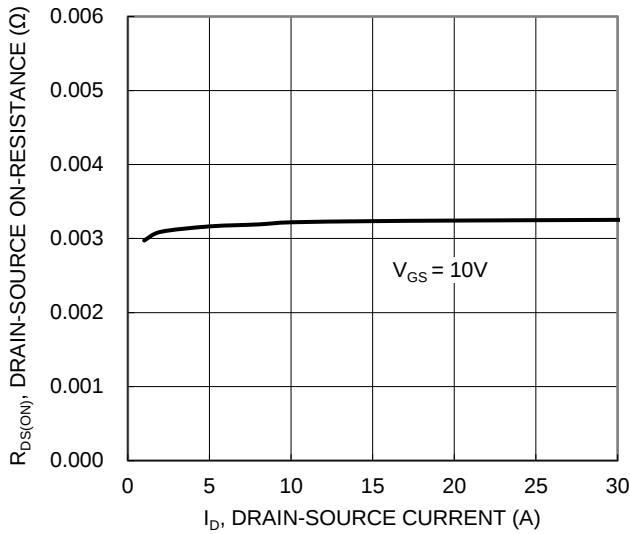


Figure 3. Typical On-Resistance vs. Drain Current and Gate Voltage

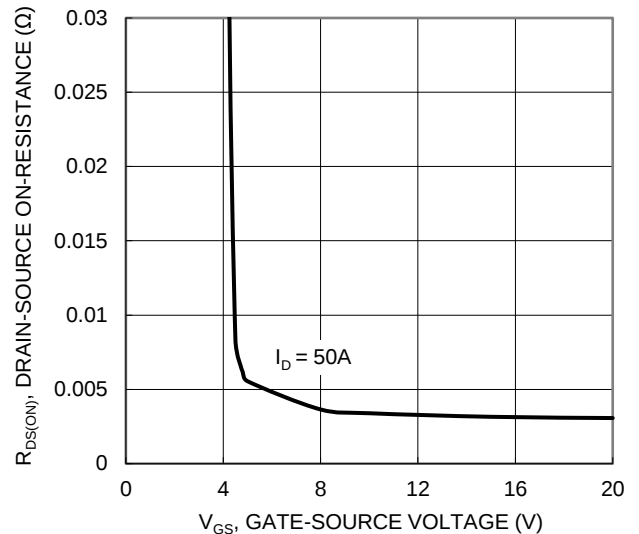


Figure 4. Typical Transfer Characteristic

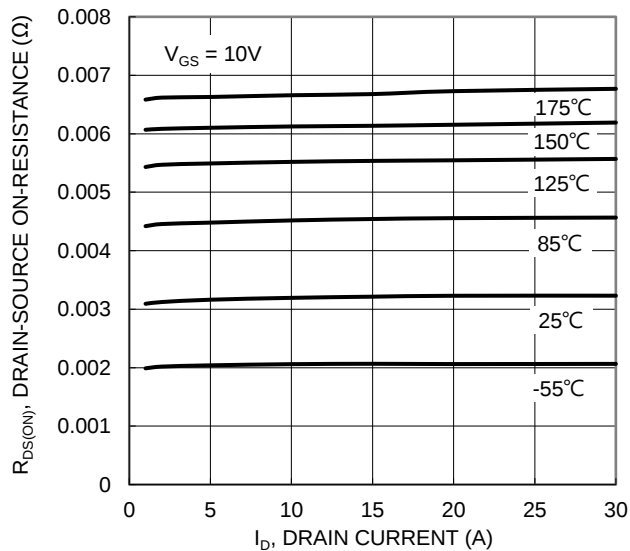


Figure 5. Typical On-Resistance vs. Drain Current and Temperature

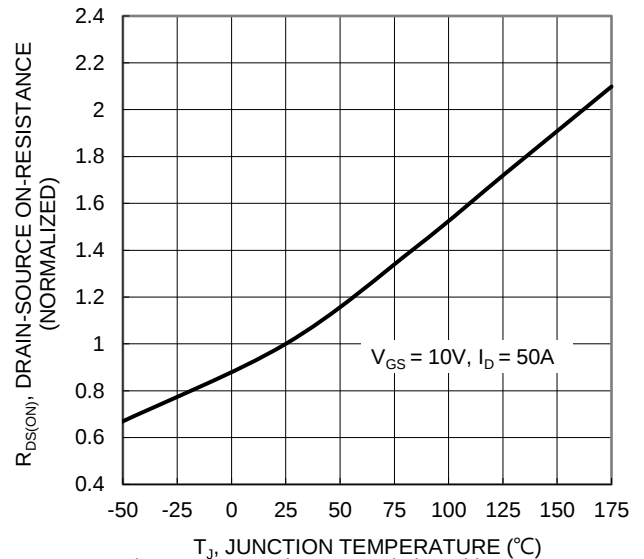


Figure 6. On-Resistance Variation with Temperature

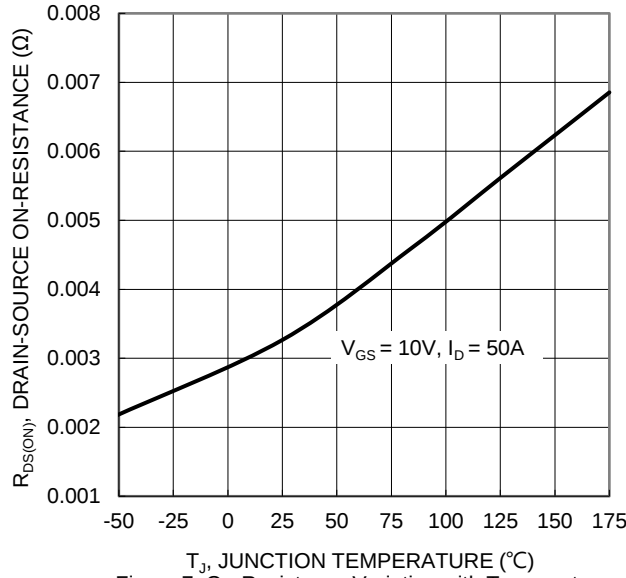


Figure 7. On-Resistance Variation with Temperature

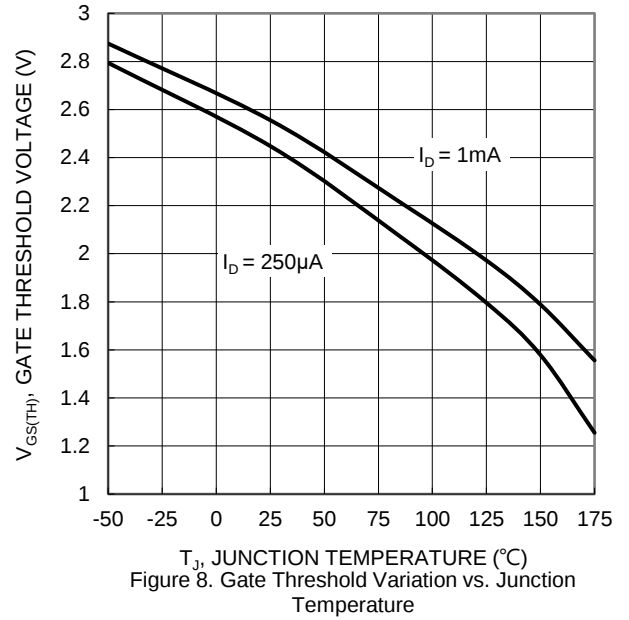


Figure 8. Gate Threshold Variation vs. Junction Temperature

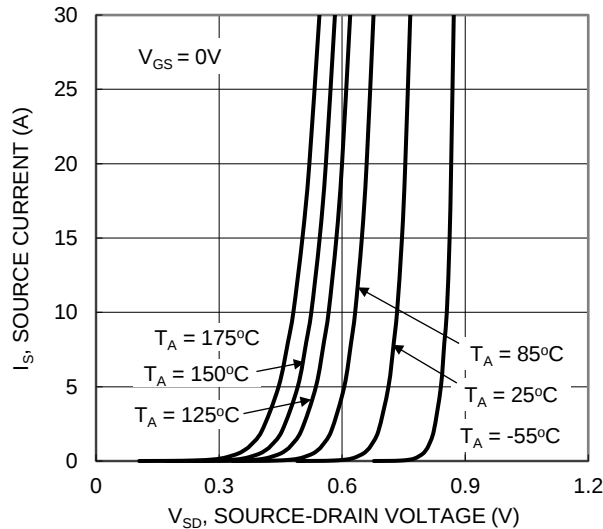


Figure 9. Diode Forward Voltage vs. Current

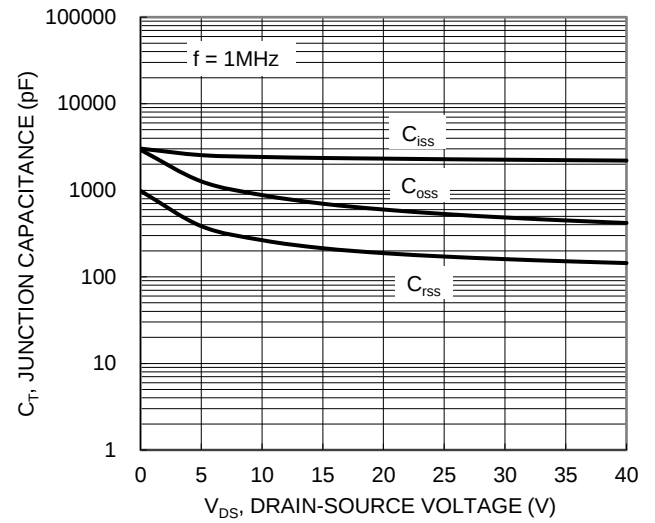


Figure 10. Typical Junction Capacitance

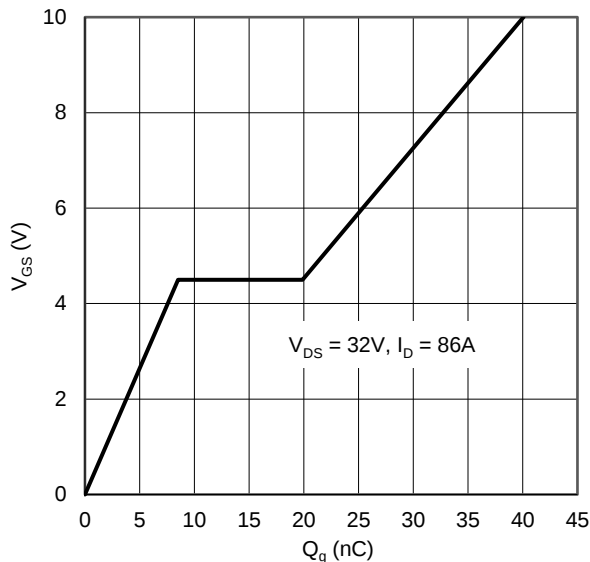


Figure 11. Gate Charge

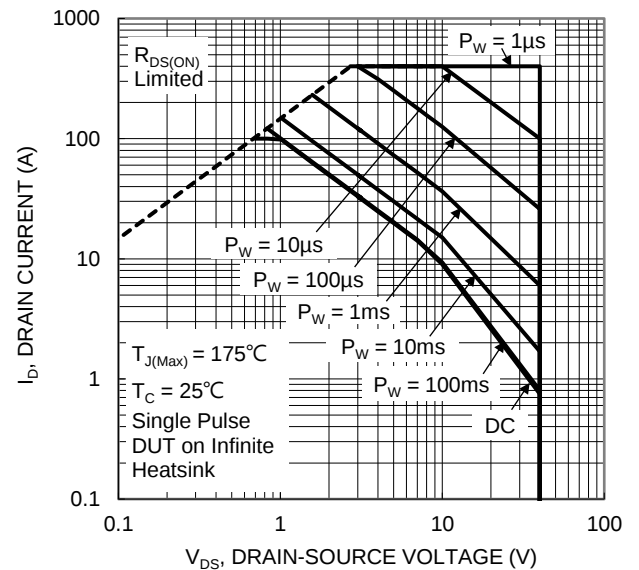


Figure 12. SOA, Safe Operation Area

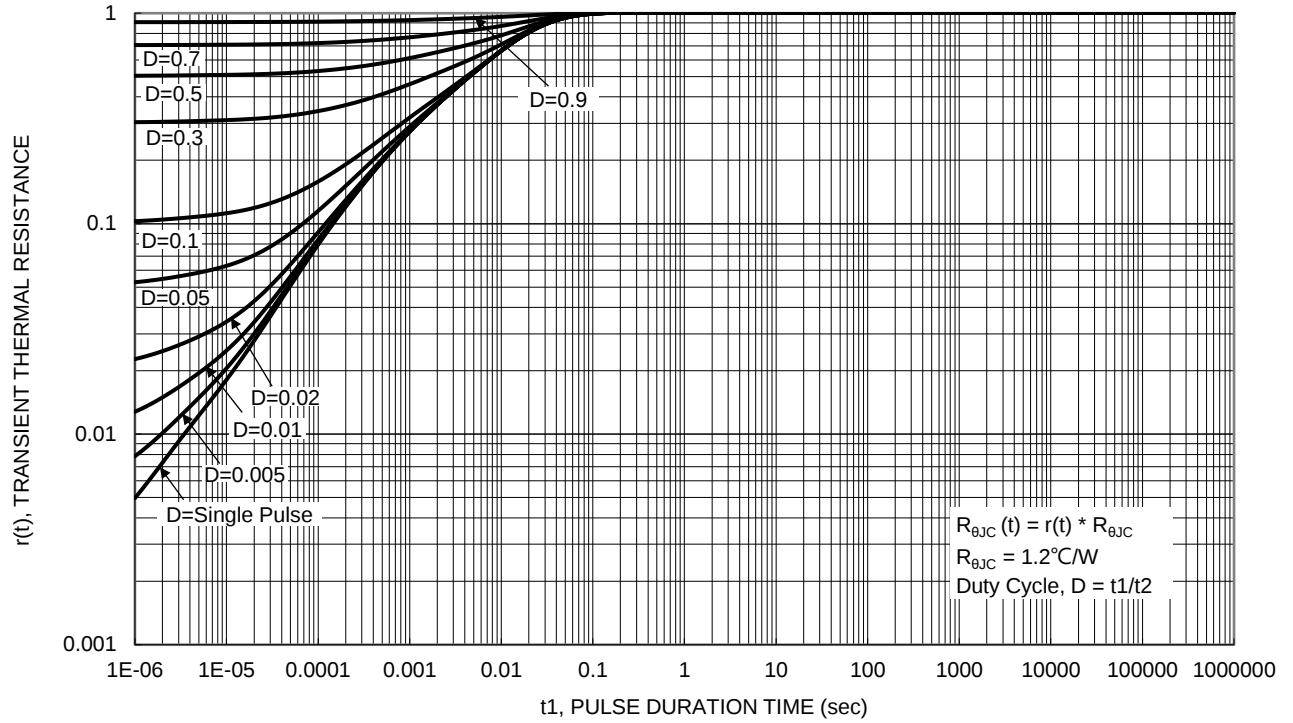
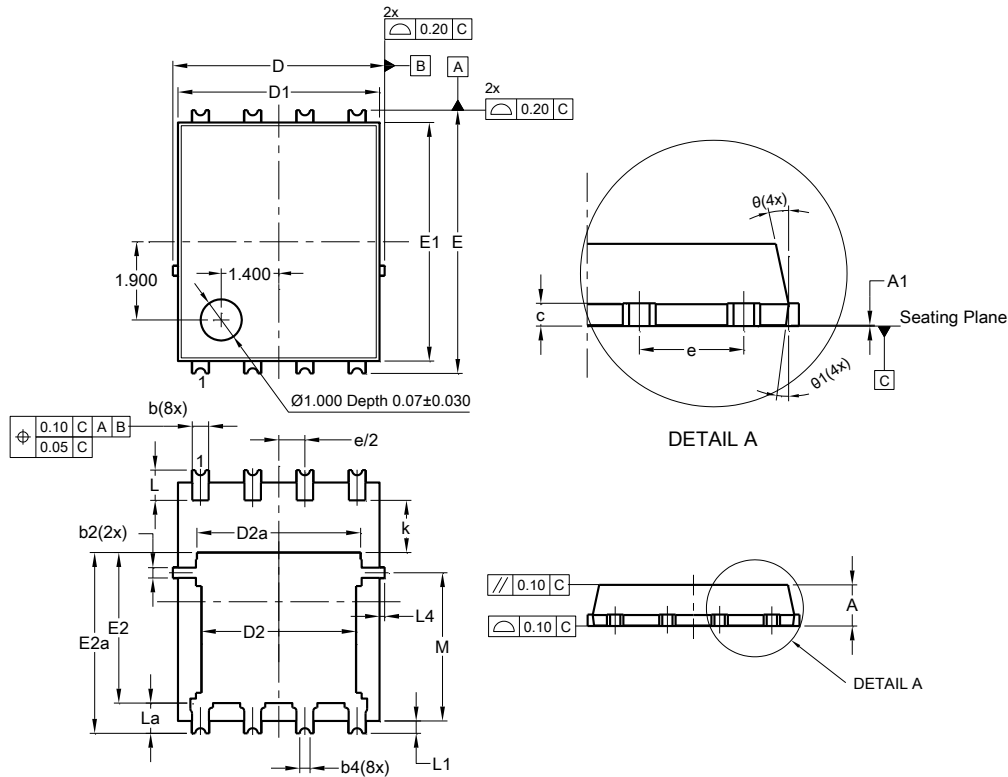


Figure 13. Transient Thermal Resistance

## Package Outline Dimensions

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

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

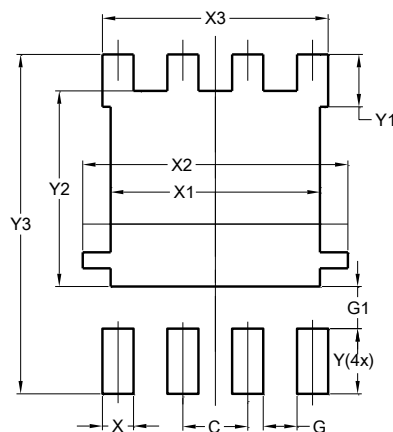


| PowerDI5060-8/SWP<br>(Type UX) |          |       |       |
|--------------------------------|----------|-------|-------|
| Dim                            | Min      | Max   | Typ   |
| A                              | 0.90     | 1.10  | 1.00  |
| A1                             | 0        | 0.05  | --    |
| 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 |
| 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 UX)



| Dimensions | Value<br>(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            |

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