

## Product Summary

| BV <sub>DSS</sub> | R <sub>DS(ON)</sub> Max       | I <sub>D</sub> Max<br>T <sub>c</sub> = +25°C |
|-------------------|-------------------------------|--|
| 60V               | 23mΩ @ V <sub>GS</sub> = 10V  | 55A  |
|                   | 28mΩ @ V <sub>GS</sub> = 4.5V | 48A  |

## Description and Applications

This MOSFET is 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.

- Driving solenoids
- Driving relays
- Power-management functions

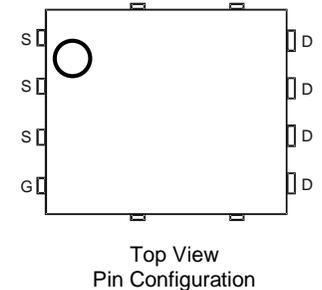
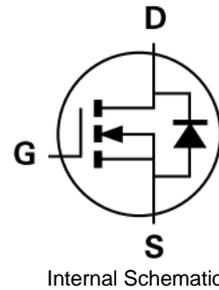
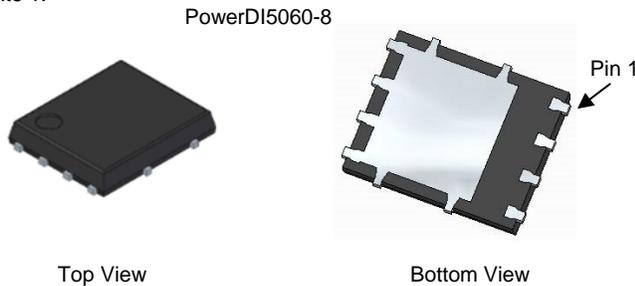
## Features and Benefits

- 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<sub>DS(ON)</sub> – Minimizes On-State Losses
- Low Input Capacitance
- Fast Switching Speed
- **Lead-Free Finish; RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. “Green” Device (Note 3)**
- **An automotive-compliant part is available under separate datasheet ([DMNH6021SPSQ](#))**

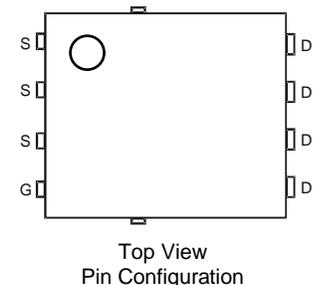
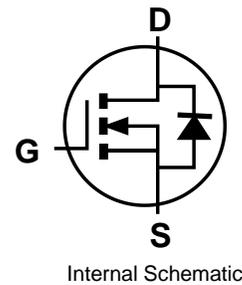
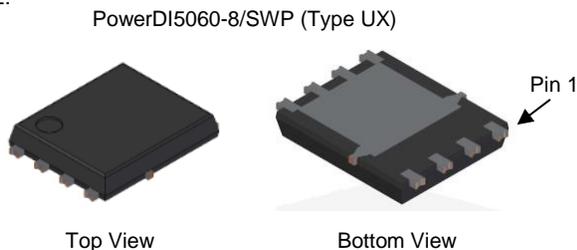
## Mechanical Data

- 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
- Terminal Finish — Matte Tin Annealed over Copper Leadframe. Solderable per MIL-STD-202, Method 208 (E3)
- Weight: 0.097 grams (Approximate)

Site 1:



Site 2:

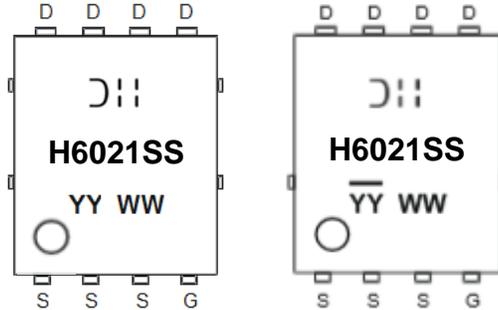


## Ordering Information (Note 4)

| Part Number    | Package                     | Packing |             |
|----------------|-----------------------------|---------|-------------|
|                |                             | Qty.    | Carrier     |
| DMNH6021SPS-13 | PowerDI5060-8               | 2,500   | Tape & Reel |
|                | PowerDI5060-8/SWP (Type UX) | 2,500   | Tape & Reel |

- Notes:
1. EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant. All applicable RoHS exemptions applied.
  2. 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.
  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. For packaging details, go to our website at <https://www.diodes.com/design/support/packaging/diodes-packaging/>.

## Marking Information



☺|| = Manufacturer's Marking  
 H6021SS = Product Type Marking Code  
 YYWW = Date Code Marking  
 YY or YY = Year (ex: 23 = 2023)  
 WW = Week (01 to 53)

## Maximum Ratings (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

| Characteristic   | Symbol    | Value   | Units |
|--|-----------|---|-------|
| Drain-Source Voltage   | $V_{DSS}$ | 60  | V     |
| Gate-Source Voltage  | $V_{GSS}$ | $\pm 20$  | V     |
| Continuous Drain Current, $V_{GS} = 10\text{V}$ (Note 5)       | $I_D$     | $T_C = +25^\circ\text{C}$<br>$T_C = +100^\circ\text{C}$ | A     |
|  |           | 55<br>39  |       |
| Maximum Continuous Body Diode Forward Current (Note 5)         | $I_S$     | 55  | A     |
| Pulsed Drain Current (10 $\mu\text{s}$ Pulse, Duty Cycle = 1%) | $I_{DM}$  | 88  | A     |
| Avalanche Current, $L = 0.1\text{mH}$ (Note 6)                 | $I_{AS}$  | 35  | A     |
| Avalanche Energy, $L = 0.1\text{mH}$ (Note 6)                  | $E_{AS}$  | 64  | mJ    |

## Thermal Characteristics

| Characteristic                                   | Symbol         | Value                     | Units            |
|--|----------------|---------------------------|------------------|
| Total Power Dissipation (Note 7)                 | $P_D$          | $T_A = +25^\circ\text{C}$ | W                |
| Thermal Resistance, Junction to Ambient (Note 7) |                | Steady State              | $R_{\theta JA}$  |
| Total Power Dissipation (Note 8)                 | $P_D$          | $T_A = +25^\circ\text{C}$ | W                |
| Thermal Resistance, Junction to Ambient (Note 8) |                | Steady State              | $R_{\theta JA}$  |
| Total Power Dissipation (Note 5)                 | $P_D$          | $T_C = +25^\circ\text{C}$ | W                |
| Thermal Resistance, Junction to Case (Note 5)    |                | $R_{\theta JC}$           | 1.5              |
| Operating and Storage Temperature Range          | $T_J, T_{STG}$ | -55 to +175               | $^\circ\text{C}$ |

- Notes:
- Thermal resistance from junction to soldering point (on the exposed drain pad).
  - $I_{AS}$  and  $E_{AS}$  ratings are based on low frequency and duty cycles to keep  $T_J = +25^\circ\text{C}$ .
  - Device mounted on FR-4 PC board, with minimum recommended pad layout, single sided.
  - Device mounted on FR-4 substrate PC board, 2oz copper, with thermal bias to bottom layer 1inch square copper plate.

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

| Characteristic                             | Symbol              | Min | Typ   | Max  | Unit | Test Condition  |
|--|---------------------|-----|-------|------|------|---|
| <b>OFF CHARACTERISTICS (Note 9)</b>        |                     |     |       |      |      |   |
| Drain-Source Breakdown Voltage             | BV <sub>DSS</sub>   | 60  | —     | —    | V    | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA  |
| Zero Gate Voltage Drain Current            | I <sub>DSS</sub>    | —   | —     | 1    | μA   | V <sub>DS</sub> = 60V, 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 9)</b>         |                     |     |       |      |      |   |
| Gate Threshold Voltage                     | V <sub>GS(TH)</sub> | 1   | —     | 3    | V    | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                                  |
| Static Drain-Source On-Resistance          | R <sub>DS(ON)</sub> | —   | 12    | 23   | mΩ   | V <sub>GS</sub> = 10V, I <sub>D</sub> = 12A   |
|  |                     | —   | 18    | 28   |      | V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 12A  |
| Diode Forward Voltage                      | V <sub>SD</sub>     | —   | 0.75  | 1.2  | V    | V <sub>GS</sub> = 0V, I <sub>S</sub> = 20A  |
| <b>DYNAMIC CHARACTERISTICS (Note 10)</b>   |                     |     |       |      |      |   |
| Input Capacitance                          | C <sub>iss</sub>    | —   | 1,016 | —    | pF   | V <sub>DS</sub> = 30V, V <sub>GS</sub> = 0V<br>f = 1MHz                                     |
| Output Capacitance                         | C <sub>oss</sub>    | —   | 153   | —    |      |   |
| Reverse Transfer Capacitance               | C <sub>rss</sub>    | —   | 76.8  | —    |      |   |
| Gate Resistance                            | R <sub>g</sub>      | —   | 2.5   | —    | Ω    | V <sub>DS</sub> = 0V, V <sub>GS</sub> = 0V, f = 1MHz  |
| Total Gate Charge (V <sub>GS</sub> = 4.5V) | Q <sub>g</sub>      | —   | 9.5   | —    | nC   | V <sub>DS</sub> = 30V, I <sub>D</sub> = 20A   |
| Total Gate Charge (V <sub>GS</sub> = 10V)  | Q <sub>g</sub>      | —   | 19.7  | —    |      |   |
| Gate-Source Charge                         | Q <sub>gs</sub>     | —   | 3.6   | —    |      |   |
| Gate-Drain Charge                          | Q <sub>gd</sub>     | —   | 4.8   | —    |      |   |
| Turn-On Delay Time                         | t <sub>D(ON)</sub>  | —   | 4.2   | —    | ns   | V <sub>DD</sub> = 30V, V <sub>GS</sub> = 10V<br>I <sub>D</sub> = 10A, R <sub>g</sub> = 4.7Ω |
| Turn-On Rise Time                          | t <sub>R</sub>      | —   | 13    | —    |      |   |
| Turn-Off Delay Time                        | t <sub>D(OFF)</sub> | —   | 27.5  | —    |      |   |
| Turn-Off Fall Time                         | t <sub>F</sub>      | —   | 15.3  | —    |      |   |
| Body Diode Reverse Recovery Time           | t <sub>RR</sub>     | —   | 20.8  | —    | ns   | I <sub>F</sub> = 20A, dI/dt = 100A/μs   |
| Body Diode Reverse Recovery Charge         | Q <sub>RR</sub>     | —   | 13.9  | —    | nC   |   |

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

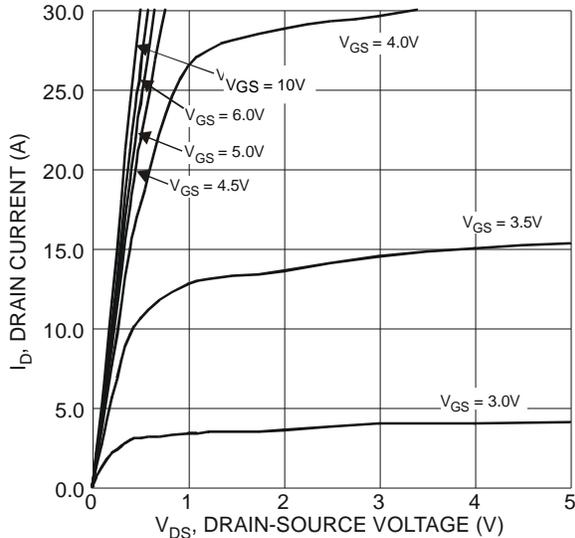


Figure 1 Typical Output Characteristics

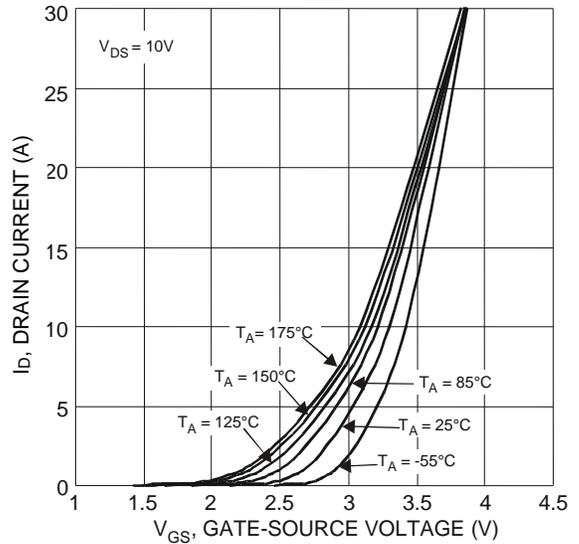


Figure 2 Typical Transfer Characteristics

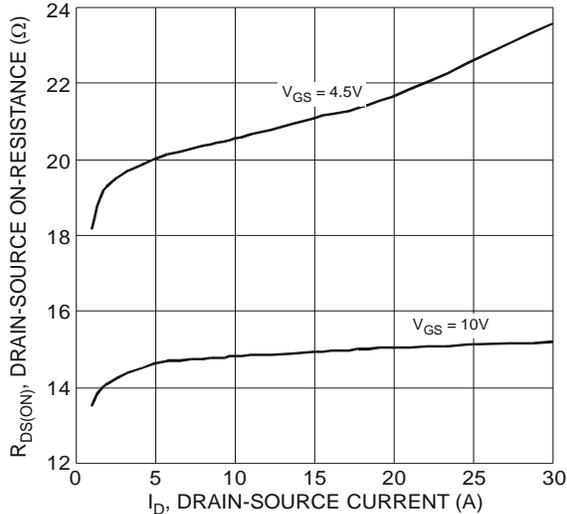


Figure 3 Typical On-Resistance vs. Drain Current and Gate Voltage

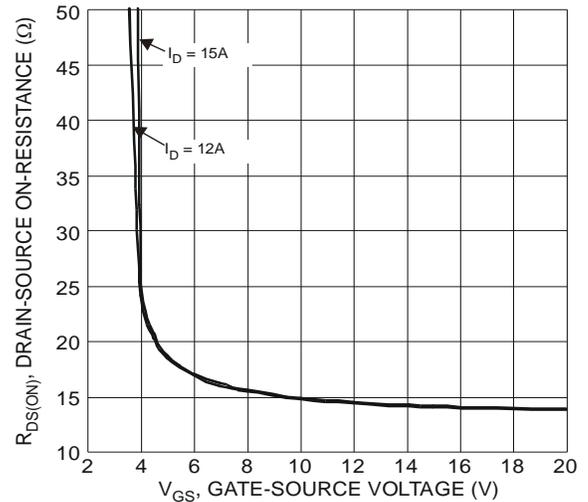


Figure 4 Typical Drain-Source On-Resistance vs. Gate-Source Voltage

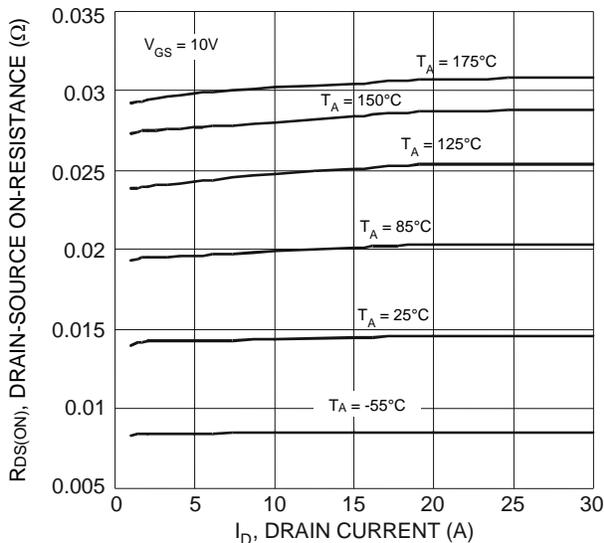


Figure 5 Typical On-Resistance vs. Drain Current and Temperature

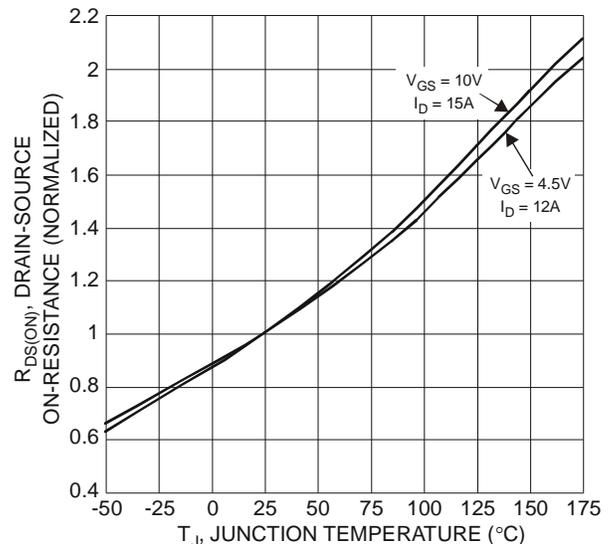


Figure 6 On-Resistance Variation with Temperature

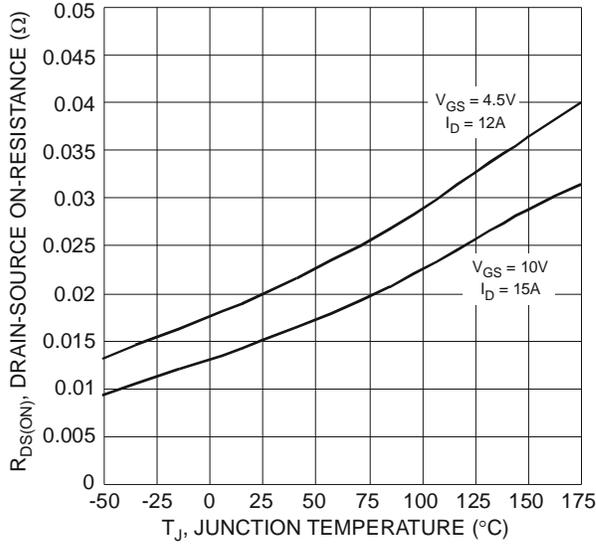


Figure 7 On-Resistance Variation with Temperature

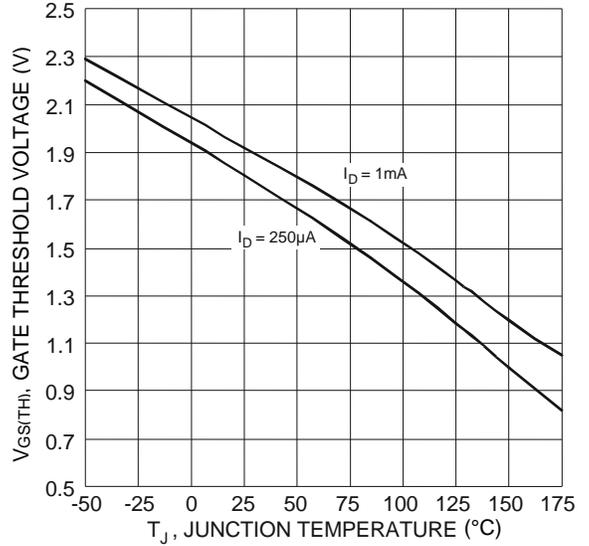


Figure 8 Gate Threshold Variation vs. Junction Temperature

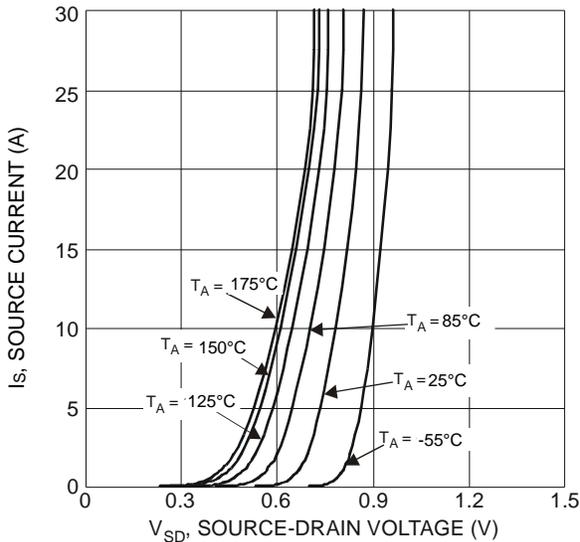


Figure 9 Diode Forward Voltage vs. Current

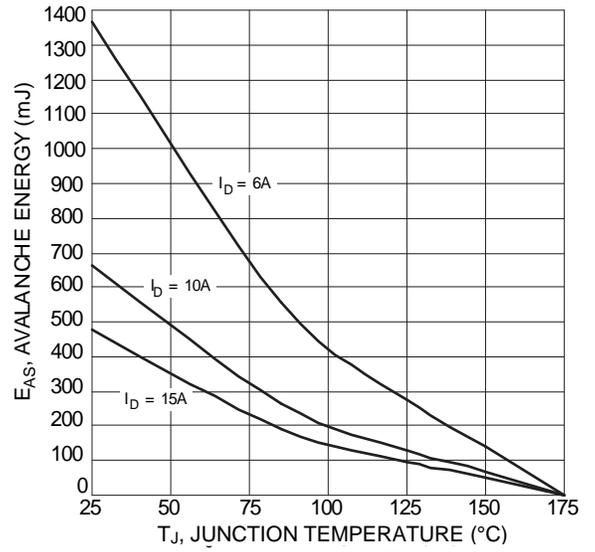


Figure 10 Avalanche Energy

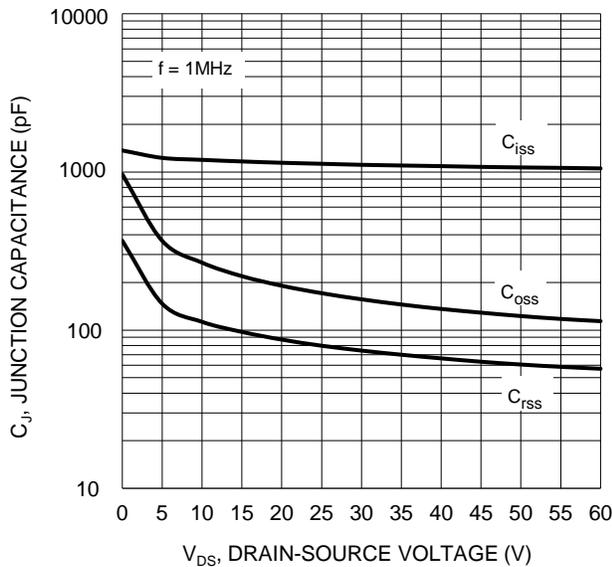


Figure 11 Typical Junction Capacitance

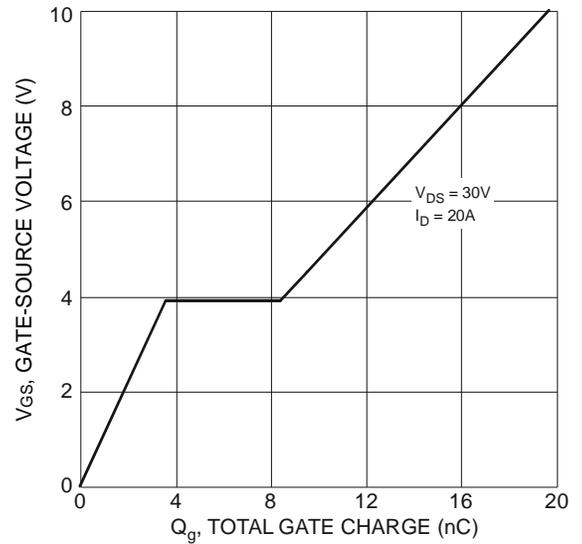


Figure 12 Gate Charge

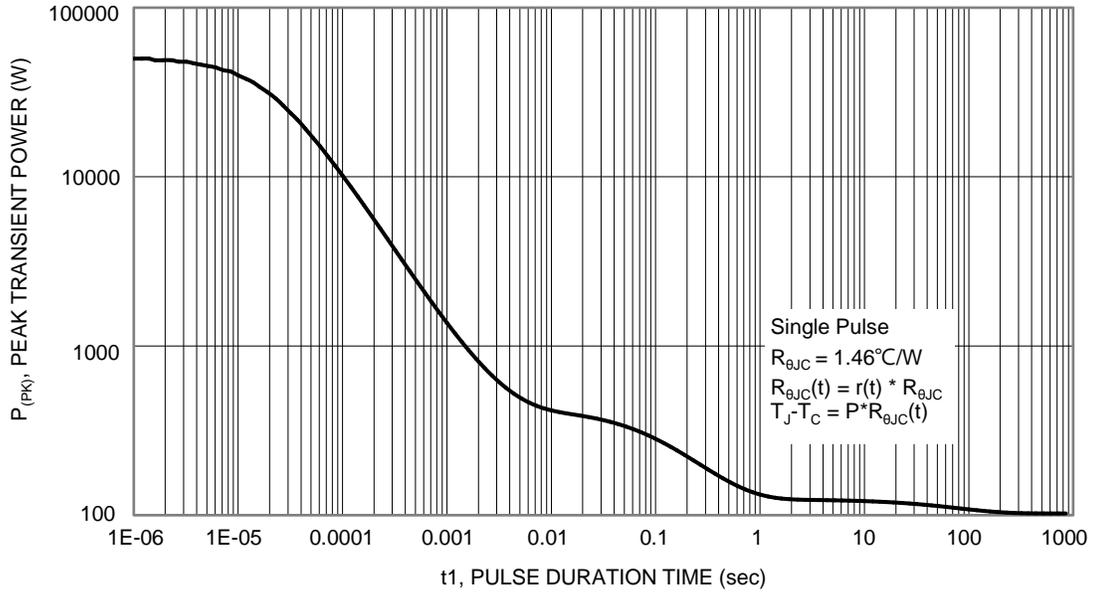


Figure 13 Single Pulse Maximum Power Dissipation

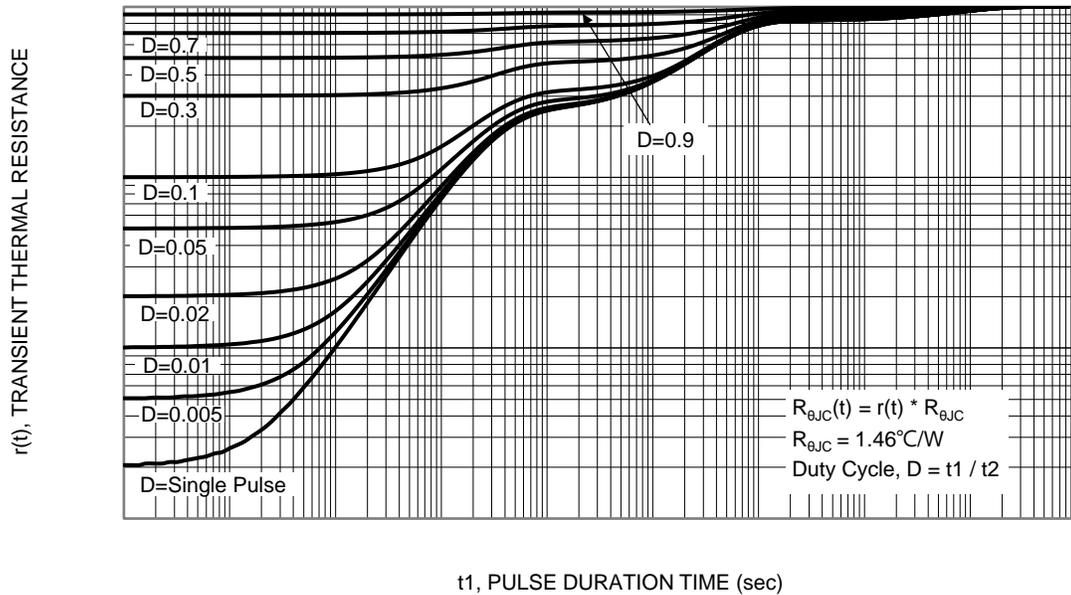


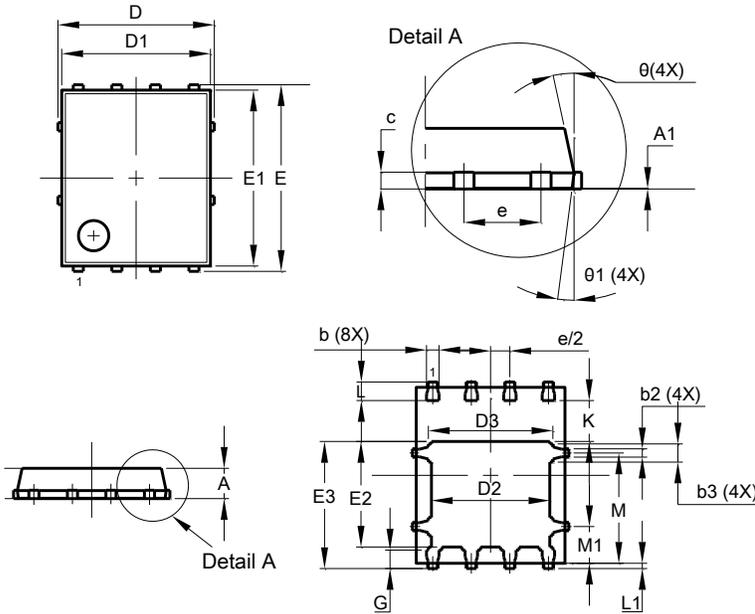
Figure 14 Transient Thermal Resistance

**Package Outline**

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

Site 1:

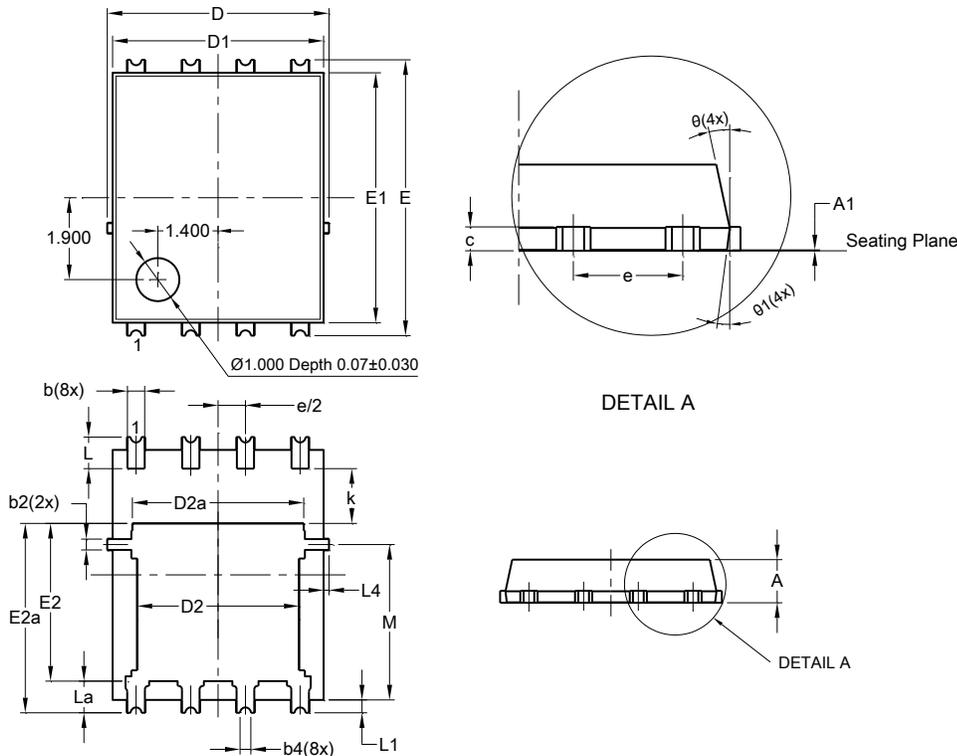
**PowerDI5060-8**



| 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)**



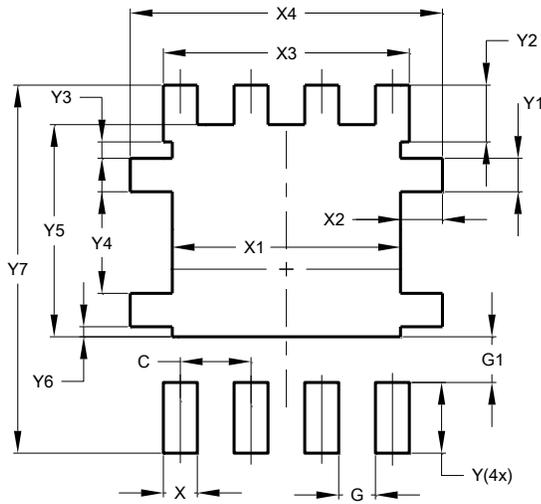
| PowerDI5060-8/SWP (Type UX) |          |       |       |
|-----------------------------|----------|-------|-------|
| Dim                         | Min      | Max   | Typ   |
| A                           | 0.90     | 1.10  | 1.00  |
| A1                          | 0        | 0.05  | --    |
| b  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

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

Site 1:

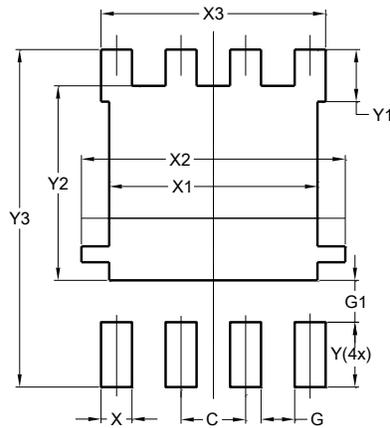
**PowerDI5060-8**



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

Site 2:

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



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

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