

## Product Summary

| $V_{(BR)DSS}$ | $R_{DS(ON)} \text{ Max}$       | $I_D$<br>$T_A = +25^\circ\text{C}$ |
|---------------|--------------------------------|------------------------------------|
| -40V          | 11mΩ @ $V_{GS} = -10\text{V}$  | -17.0A                             |
|               | 15mΩ @ $V_{GS} = -4.5\text{V}$ | -14.5A                             |

## Description

This new generation MOSFET is designed to minimize the on-state resistance ( $R_{DS(ON)}$ ), yet maintain superior switching performance, making it ideal for high efficiency power management applications.

## Applications

- DC-DC Converters
- Power Management Functions
- Analog Switch

## Features and Benefits

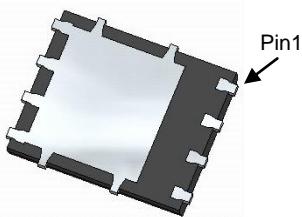
- 100% Unclamped Inductive Switch (UIS) Test in Production
- Low On-Resistance
- Fast Switching Speed
- Lead-Free Finish; RoHS Compliant (Notes 1 & 2)**
- Halogen and Antimony Free. "Green" Device (Note 3)**
- Qualified to AEC-Q101 Standards for High Reliability
- PPAP Capable (Note 4)

## Mechanical Data

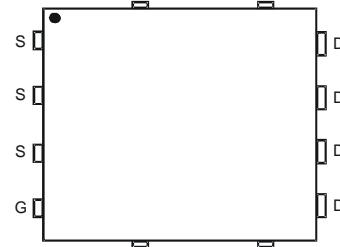
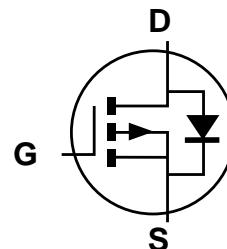
- Case: PowerDI® 5060-8
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – 100% Matte Tin Annealed over Copper Leadframe. Solderable per MIL-STD-202, Method 208 (e3)
- Weight: 0.097 grams (Approximate)



Top View



Bottom View


 Top View  
 Pin Configuration


Internal Schematic

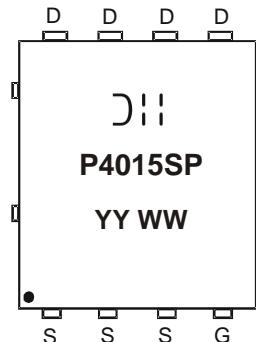
## Ordering Information (Note 5)

| Part Number    | Compliance | Case          | Packaging         |
|----------------|------------|---------------|-------------------|
| DMP4015SPSQ-13 | Automotive | PowerDI5060-8 | 2,500/Tape & Reel |

## Notes:

- EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant. All applicable RoHS exemptions applied.
- See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) 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.
- Automotive products are AEC-Q101 qualified and are PPAP capable. Refer to [http://www.diodes.com/quality/product\\_compliance\\_definitions/](http://www.diodes.com/quality/product_compliance_definitions/).
- For packaging details, go to our website at <http://www.diodes.com/products/packages.html>.

## Marking Information



**DII** = Manufacturer's Marking  
**P4015SP** = Product Type Marking Code  
**YYWW** = Date Code Marking  
**YY** = Year (ex: 13 = 2013)  
**WW** = Week (01 - 53)

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

| Characteristic   | Symbol           | Value  | Units |
|--|------------------|--|-------|
| Drain-Source Voltage   | $V_{DSS}$        | -40  | V     |
| Gate-Source Voltage  | $V_{GSS}$        | $\pm 25$   | V     |
| Continuous Drain Current (Note 6) $V_{GS} = -10\text{V}$       | Steady State     | $T_A = +25^\circ\text{C}$<br>$T_A = +70^\circ\text{C}$ | $I_D$ |
|  | $t < 10\text{s}$ | $T_A = +25^\circ\text{C}$<br>$T_A = +70^\circ\text{C}$ | $I_D$ |
| Continuous Drain Current (Note 7) $V_{GS} = -10\text{V}$       | Steady State     | $T_A = +25^\circ\text{C}$<br>$T_A = +70^\circ\text{C}$ | $I_D$ |
|  | $t < 10\text{s}$ | $T_A = +25^\circ\text{C}$<br>$T_A = +70^\circ\text{C}$ | $I_D$ |
| Pulsed Drain Current (10 $\mu\text{s}$ Pulse, Duty Cycle = 1%) | $I_{DM}$         | -100   | A     |
| Maximum Body Diode Continuous Current (Note 7)                 | $I_S$            | -3.5   | A     |
| Avalanche Current (Note 8)                                     | $I_{AS}$         | -22  | A     |
| Avalanche Energy (Note 8)                                      | $E_{AS}$         | 242  | mJ    |

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

| Characteristic                                   | Symbol          | Value       | Units                     |
|--|-----------------|-------------|---------------------------|
| Total Power Dissipation (Note 6)                 | $P_D$           | 1.3         | W                         |
|  |                 | 0.8         |                           |
| Thermal Resistance, Junction to Ambient (Note 6) | $R_{\theta JA}$ | 96.4        | $^\circ\text{C}/\text{W}$ |
|  |                 | 40.6        |                           |
| Total Power Dissipation (Note 7)                 | $P_D$           | 2.1         | W                         |
|  |                 | 1.4         |                           |
| Thermal Resistance, Junction to Ambient (Note 7) | $R_{\theta JA}$ | 55.0        | $^\circ\text{C}/\text{W}$ |
|  |                 | 24.0        |                           |
| Thermal Resistance, Junction to Case (Note 7)    | $R_{\theta JC}$ | 4.15        | $^\circ\text{C}/\text{W}$ |
| Operating and Storage Temperature Range          | $T_J, T_{STG}$  | -55 to +150 | $^\circ\text{C}$          |

Notes:

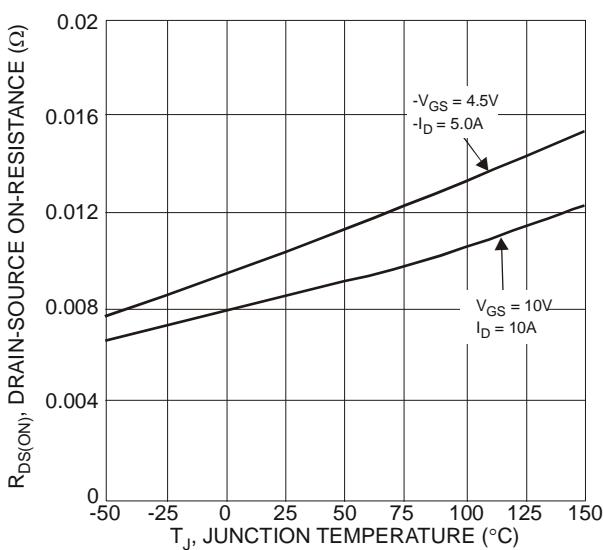
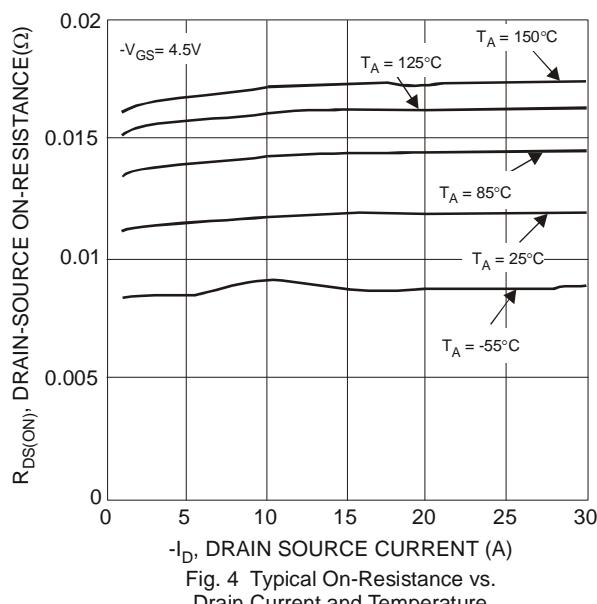
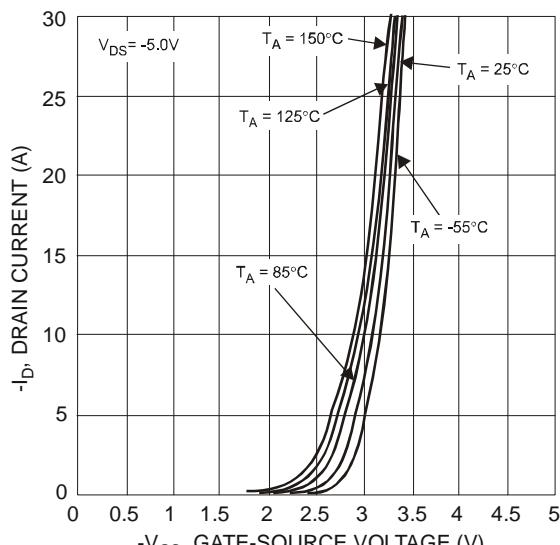
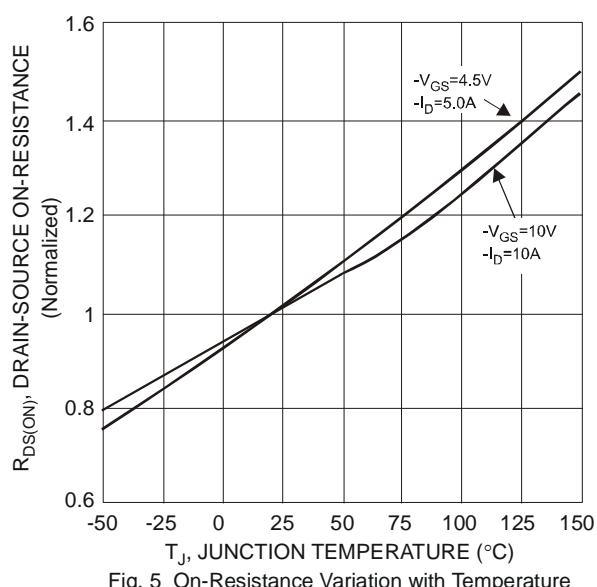
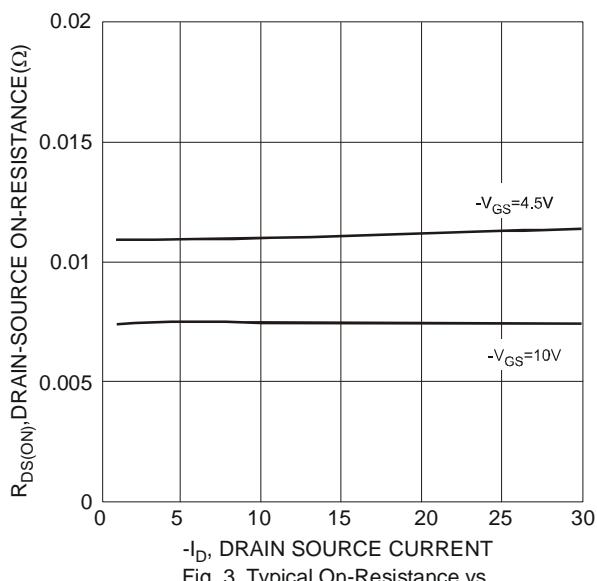
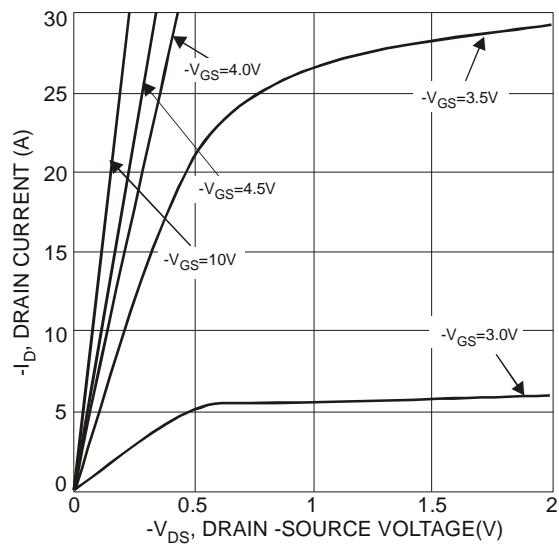
6. Device mounted on FR-4 PC board, with minimum recommended pad layout, single sided.
7. Device mounted on FR-4 substrate PC board, 2oz copper, with thermal bias to bottom layer 1inch square copper plate.
8. UIS in production with  $L = 0.1\text{mH}$ ,  $T_J = +25^\circ\text{C}$ .

**Electrical Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

| Characteristic                           | Symbol                     | Min  | Typ   | Max       | Unit             | Test Condition   |
|--|----------------------------|------|-------|-----------|------------------|--|
| <b>OFF CHARACTERISTICS</b> (Note 9)      |                            |      |       |           |                  |  |
| Drain-Source Breakdown Voltage           | $\text{BV}_{\text{DSS}}$   | -40  | —     | —         | V                | $V_{\text{GS}} = 0\text{V}$ , $I_D = -250\mu\text{A}$  |
| Zero Gate Voltage Drain Current          | $I_{\text{DSS}}$           | —    | —     | -1        | $\mu\text{A}$    | $V_{\text{DS}} = -40\text{V}$ , $V_{\text{GS}} = 0\text{V}$  |
| Gate-Source Leakage                      | $I_{\text{GSS}}$           | —    | —     | $\pm 100$ | nA               | $V_{\text{GS}} = \pm 25\text{V}$ , $V_{\text{DS}} = 0\text{V}$   |
| <b>ON CHARACTERISTICS</b> (Note 9)       |                            |      |       |           |                  |  |
| Gate Threshold Voltage                   | $V_{\text{GS}(\text{th})}$ | -1.5 | -2    | -2.5      | V                | $V_{\text{DS}} = V_{\text{GS}}$ , $I_D = -250\mu\text{A}$  |
| Static Drain-Source On-Resistance        | $R_{\text{DS}(\text{ON})}$ | —    | 7     | 11        | $\text{m}\Omega$ | $V_{\text{GS}} = -10\text{V}$ , $I_D = -9.8\text{A}$   |
|  |                            | —    | 9     | 15        |                  | $V_{\text{GS}} = -4.5\text{V}$ , $I_D = -9.8\text{A}$  |
| Forward Transfer Admittance              | $ Y_{\text{fs}} $          | —    | 26    | —         | S                | $V_{\text{DS}} = -20\text{V}$ , $I_D = -9.8\text{A}$   |
| Diode Forward Voltage                    | $V_{\text{SD}}$            | —    | -0.7  | -1        | V                | $V_{\text{GS}} = 0\text{V}$ , $I_S = -1\text{A}$   |
| <b>DYNAMIC CHARACTERISTICS</b> (Note 10) |                            |      |       |           |                  |  |
| Input Capacitance                        | $C_{\text{iss}}$           | —    | 4,234 | —         | pF               | $V_{\text{DS}} = -20\text{V}$ , $V_{\text{GS}} = 0\text{V}$<br>$f = 1\text{MHz}$   |
| Output Capacitance                       | $C_{\text{oss}}$           | —    | 1,036 | —         |                  |  |
| Reverse Transfer Capacitance             | $C_{\text{rss}}$           | —    | 526   | —         |                  |  |
| Gate Resistance                          | $R_G$                      | —    | 7.77  | —         | $\Omega$         | $V_{\text{DS}} = 0\text{V}$ , $V_{\text{GS}} = 0\text{V}$ , $f = 1\text{MHz}$  |
| Total Gate Charge                        | $Q_g$                      | —    | 47.5  | —         | nC               | $V_{\text{DS}} = -20\text{V}$ , $V_{\text{GS}} = -5\text{V}$<br>$I_D = -9.8\text{A}$                                       |
| Gate-Source Charge                       | $Q_{\text{gs}}$            | —    | 14.2  | —         |                  |  |
| Gate-Drain Charge                        | $Q_{\text{gd}}$            | —    | 13.5  | —         |                  |  |
| Turn-On Delay Time                       | $t_{\text{D}(\text{on})}$  | —    | 13.2  | —         | ns               | $V_{\text{GS}} = -10\text{V}$ , $V_{\text{DD}} = -20\text{V}$ , $R_G = 6\Omega$ ,<br>$I_D = -1\text{A}$ , $R_L = 20\Omega$ |
| Turn-On Rise Time                        | $t_r$                      | —    | 10    | —         |                  |  |
| Turn-Off Delay Time                      | $t_{\text{D}(\text{off})}$ | —    | 302.7 | —         |                  |  |
| Turn-Off Fall Time                       | $t_f$                      | —    | 137.9 | —         |                  |  |

Notes: 9. Short duration pulse test used to minimize self-heating effect.

10. Guaranteed by design. Not subject to production testing.



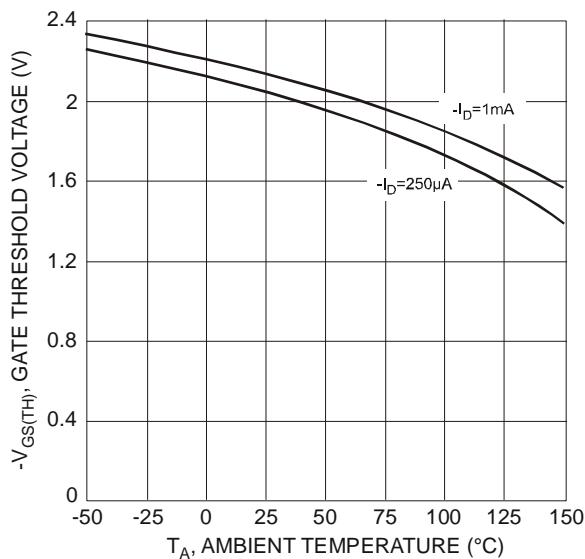


Fig. 7 Gate Threshold Variation vs. Ambient Temperature

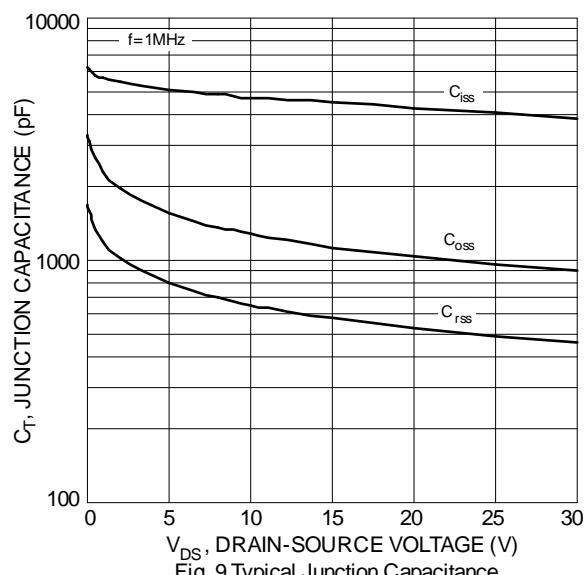


Fig. 9 Typical Junction Capacitance

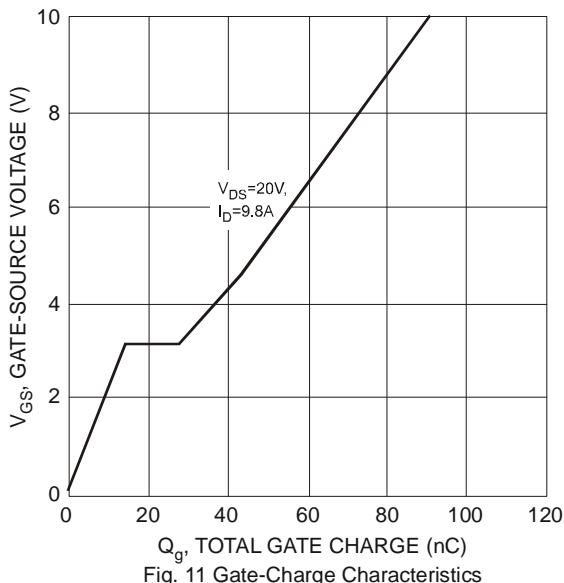


Fig. 11 Gate-Charge Characteristics

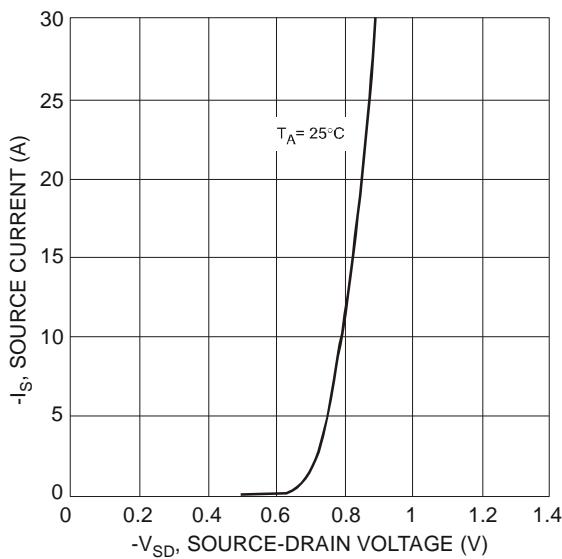


Fig. 8 Diode Forward Voltage vs. Current

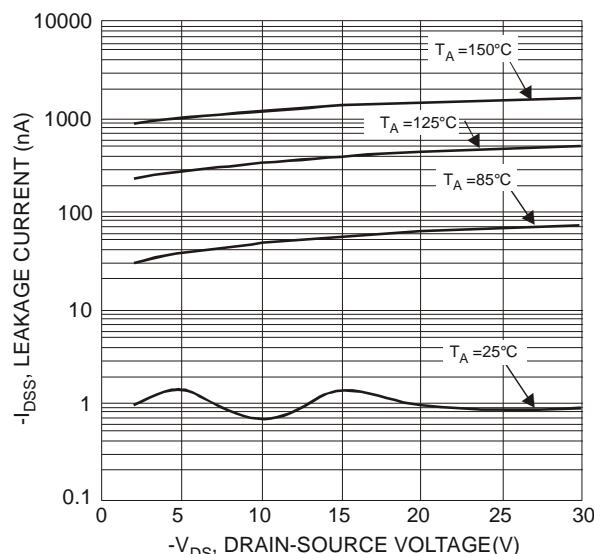


Fig. 10 Typical Drain-Source Leakage Current vs. Voltage

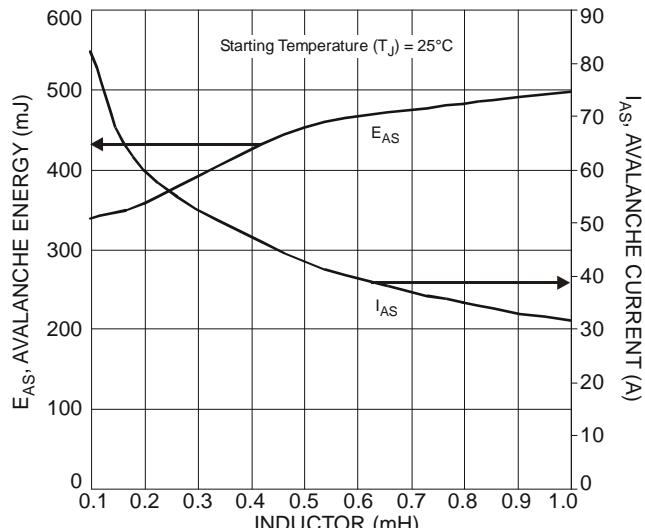


Fig. 12 Single-Pulse Avalanche Tested

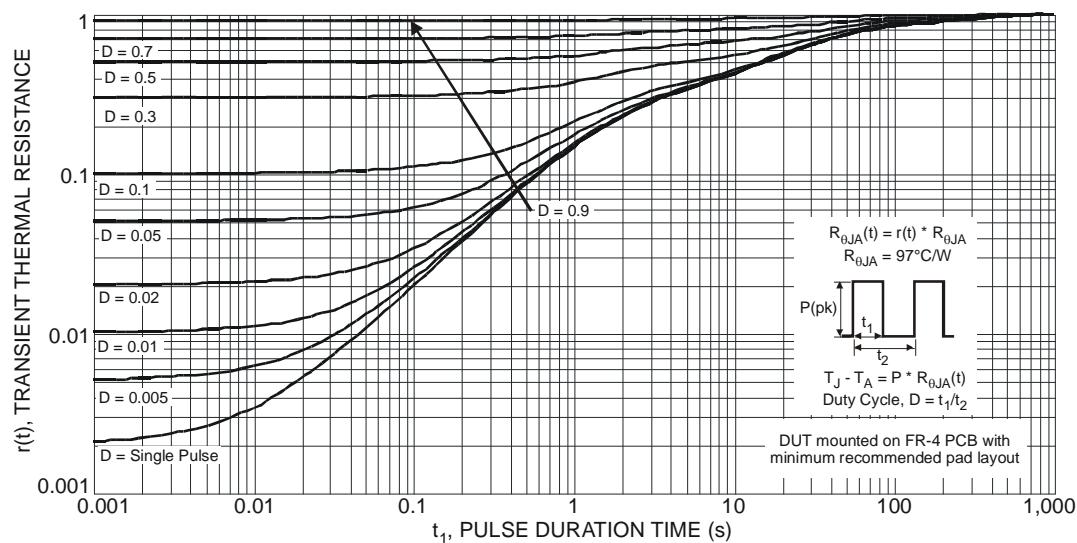
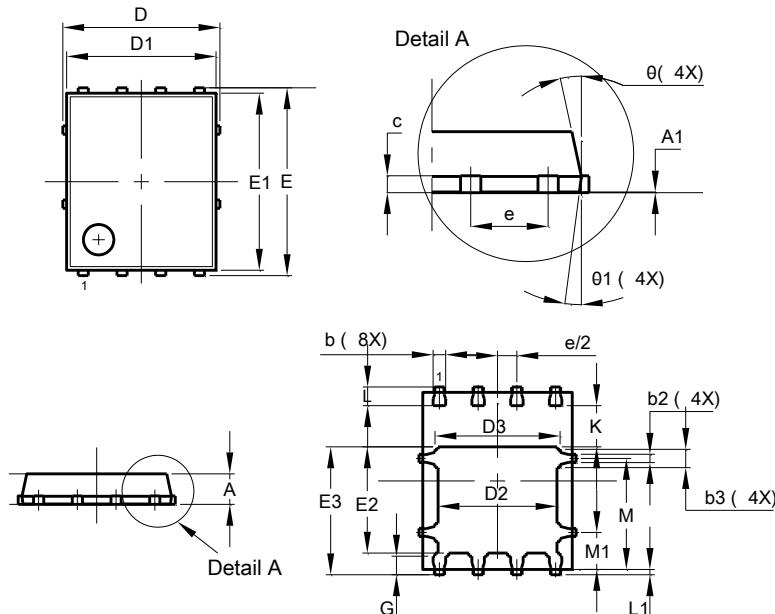


Fig. 13 Transient Thermal Response

## Package Outline Dimensions

Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.

## PowerDI5060-8



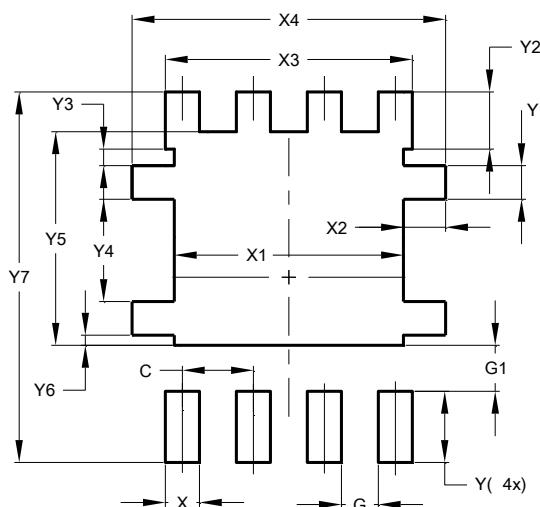
| PowerDI5060-8 |          |       |       |
|---------------|----------|-------|-------|
| Dim           | Min      | Max   | Typ   |
| <b>A</b>      | 0.90     | 1.10  | 1.00  |
| <b>A1</b>     | 0.00     | 0.05  | —     |
| <b>b</b>      | 0.33     | 0.51  | 0.41  |
| <b>b2</b>     | 0.200    | 0.350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

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## Suggested Pad Layout

Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

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         |

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