

Product Summary

BV _{DSS}	R _{DS(ON)} Max	I _D T _C = +25°C
-40V	13mΩ @ V _{GS} = -10V	-69A
	23mΩ @ V _{GS} = -4.5V	-52A

Features and Benefits

- Rated to +175°C – Ideal for High Ambient Temperature Environments
- 100% Unclamped Inductive Switching (UIS) Test in Production – Ensures More Reliable and Robust End Application
- Low On-Resistance
- Fast Switching Speed
- 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-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please [contact us](mailto:contact@diodes.com) or your local Diodes representative.
<https://www.diodes.com/quality/product-definitions/>

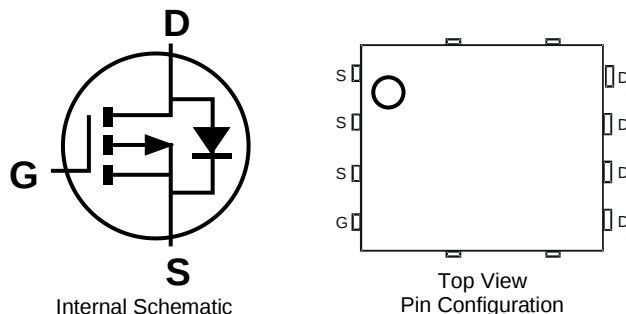
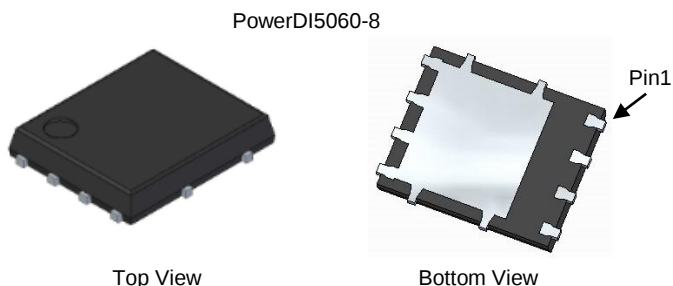
Description and Applications

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

- Reverse Polarity Protection
- BLDC Motor Control
- Power Management Functions

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 Connections: See Diagram
- Terminals: Finish – 100% Matte Tin Annealed over Copper Leadframe. Solderable per MIL-STD-202, Method 208③
- Weight: 0.097 grams (Approximate)

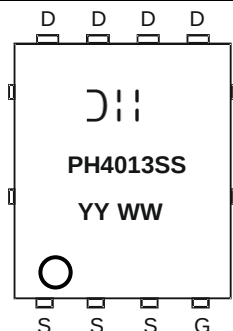


Ordering Information (Note 4)

Part Number	Case	Packaging
DMPH4013SPS-13	PowerDI5060-8	2,500 / Tape & 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/>.

Marking Information



⌐⌐⌐ = Manufacturer's Marking
 PH4013SS = Product Type Marking Code
 YYWW = Date Code Marking
 YY = Year (ex: 20 = 2020)
 WW = Week (01 to 53)

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 V _{GS} = -10V (Note 7)	I _D	-69 -49	A
Pulsed Drain Current (10μs Pulse, Duty Cycle = 1%)	I _{DM}	-277	A
Maximum Body Diode Continuous Current (Note 7)	I _S	-69	A
Pulsed Source Current (10μs Pulse, Duty Cycle = 1%)	I _{SM}	-277	A
Avalanche Current (Note 8) L = 1mH	I _{AS}	-22	A
Avalanche Energy (Note 8) L = 1mH	E _{AS}	260	mJ

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

Characteristic	Symbol	Value	Unit
Total Power Dissipation (Note 5)	P _D	1.5	W
Thermal Resistance, Junction to Ambient (Note 5)	R _{θJA}	98	°C/W
Total Power Dissipation (Note 6)	P _D	3.3	W
Thermal Resistance, Junction to Ambient (Note 6)	R _{θJA}	45	°C/W
Thermal Resistance, Junction to Case (Note 7)	R _{θJC}	1.6	°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 9)						
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 9)						
Gate Threshold Voltage	V _{GS(TH)}	-1	-1.8	-3	V	V _{DS} = V _{GS} , I _D = -250μA
Static Drain-Source On-Resistance	R _{DS(ON)}	—	9	13	mΩ	V _{GS} = -10V, I _D = -10A
		—	12.4	23		V _{GS} = -4.5V, I _D = -8A
Diode Forward Voltage	V _{SD}	—	-0.70	-1.2	V	V _{GS} = 0V, I _S = -1A
DYNAMIC CHARACTERISTICS (Note 10)						
Input Capacitance	C _{iss}	—	4763	—	pF	V _{DS} = -20V, V _{GS} = 0V f = 1MHz
Output Capacitance	C _{oss}	—	539	—		
Reverse Transfer Capacitance	C _{rss}	—	403	—		
Gate Resistance	R _g	—	7.4	—	Ω	V _{DS} = 0V, V _{GS} = 0V, f = 1MHz
Total Gate Charge (V _{GS} = -4.5V)	Q _g	—	39	—	nC	V _{DS} = -20V, I _D = -10A
Total Gate Charge (V _{GS} = -10V)	Q _g	—	87	—		
Gate-Source Charge	Q _{gs}	—	12.5	—		
Gate-Drain Charge	Q _{gd}	—	15	—		
Turn-On Delay Time	t _{d(ON)}	—	6.2	—	ns	V _{GS} = -10V, V _{DD} = -20V, R _G = 3Ω, I _D = -10A
Turn-On Rise Time	t _r	—	4.8	—		
Turn-Off Delay Time	t _{d(OFF)}	—	126	—		
Turn-Off Fall Time	t _f	—	57	—		
Reverse Recovery Time	t _{RR}	—	27	—	ns	I _F = -10A, di/dt = -100A/μs
Reverse Recovery Charge	Q _{RR}	—	21	—	nC	I _F = -10A, di/dt = -100A/μs

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

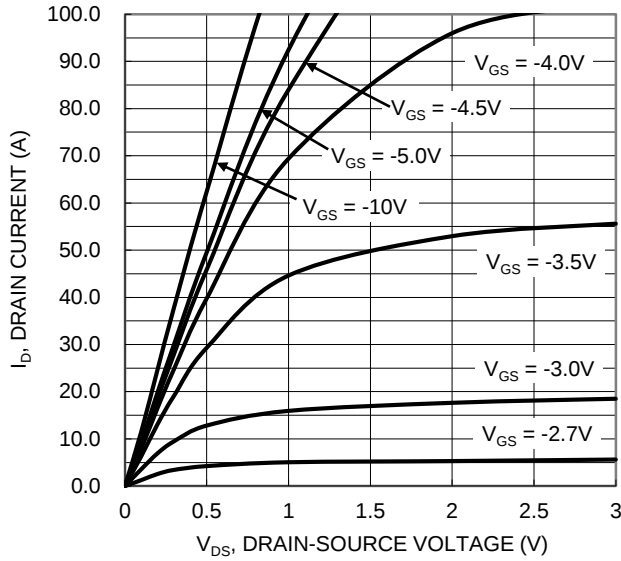


Figure 1. Typical Output Characteristic

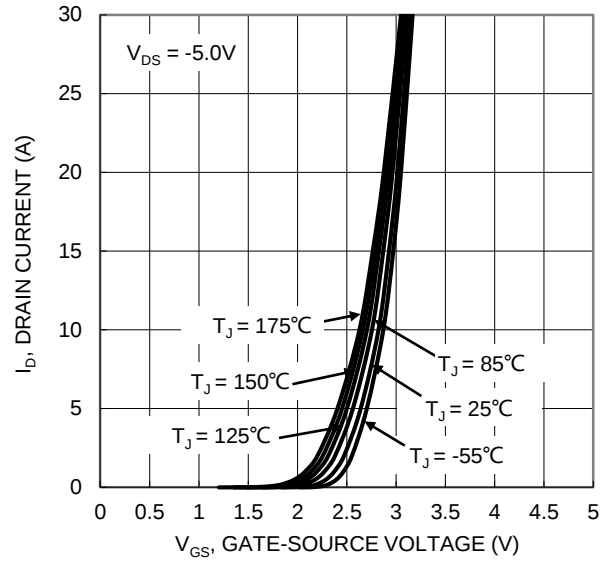


Figure 2. Typical Transfer Characteristic

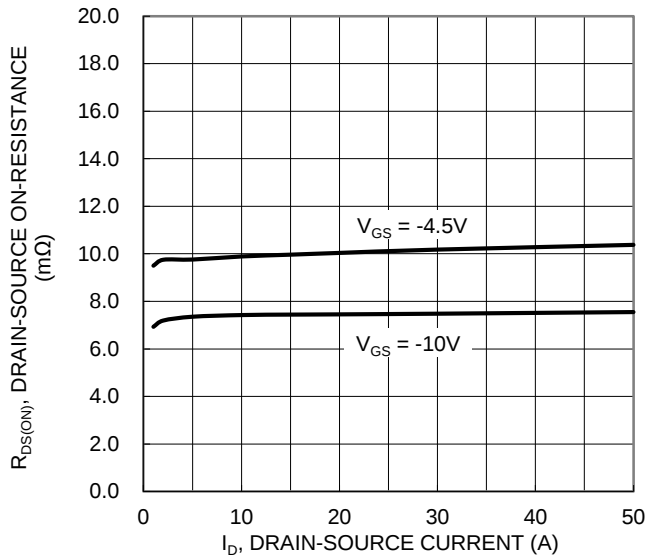


Figure 3. Typical On-Resistance vs. Drain Current and Gate Voltage

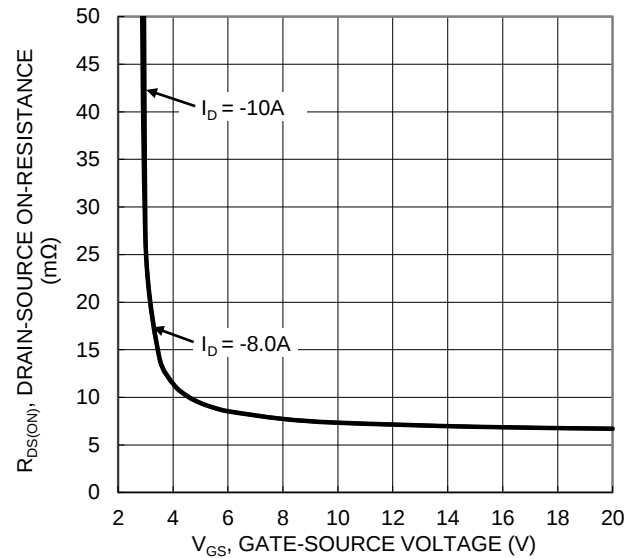


Figure 4. Typical Transfer Characteristic

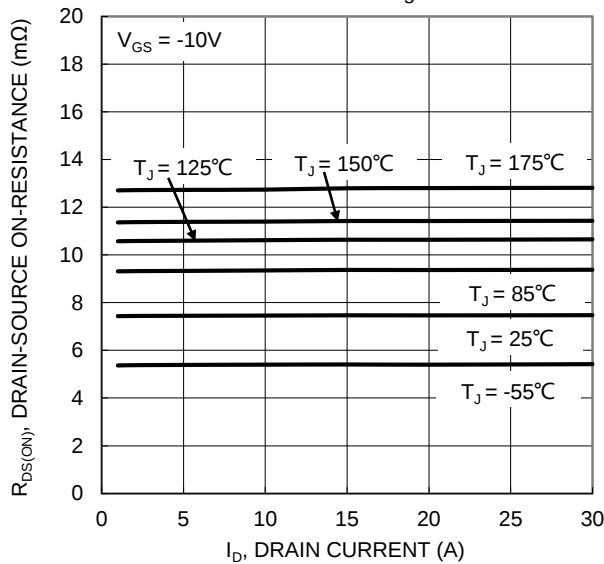


Figure 5. Typical On-Resistance vs. Drain Current and Temperature

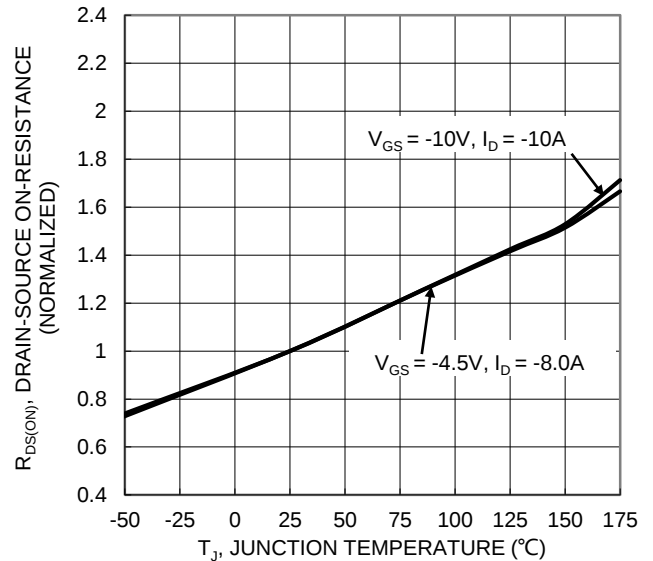


Figure 6. On-Resistance Variation with Temperature

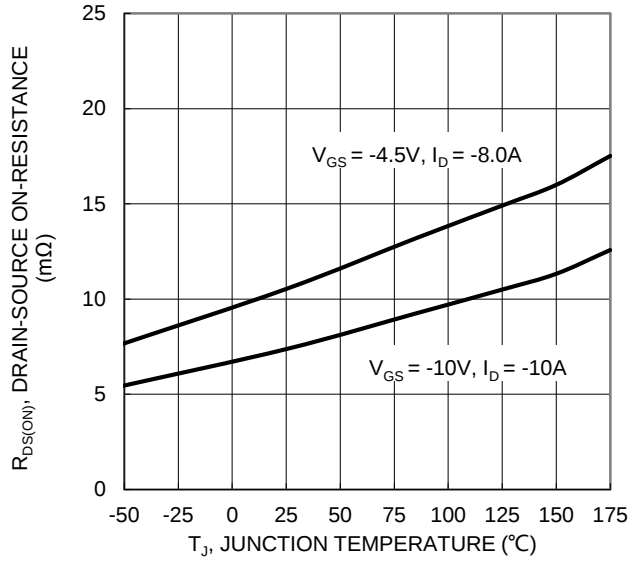


Figure 7. On-Resistance Variation with Temperature

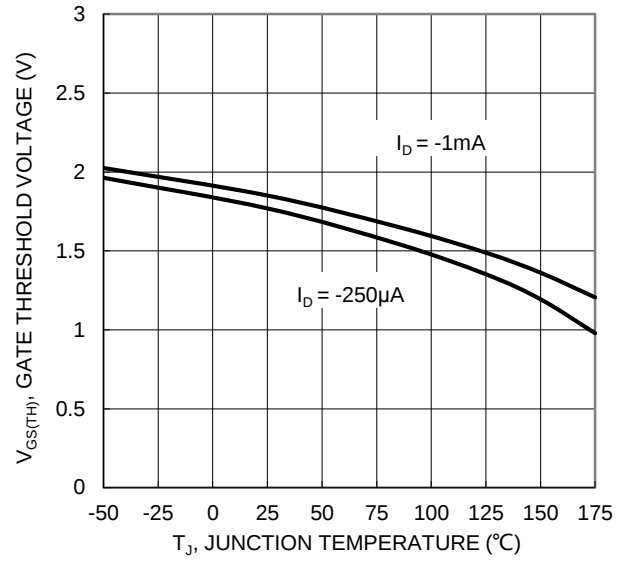


Figure 8. Gate Threshold Variation vs. Junction Temperature

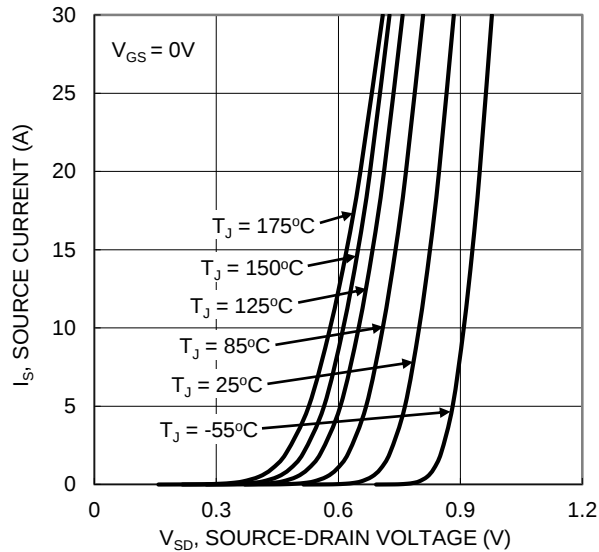


Figure 9. Diode Forward Voltage vs. Current

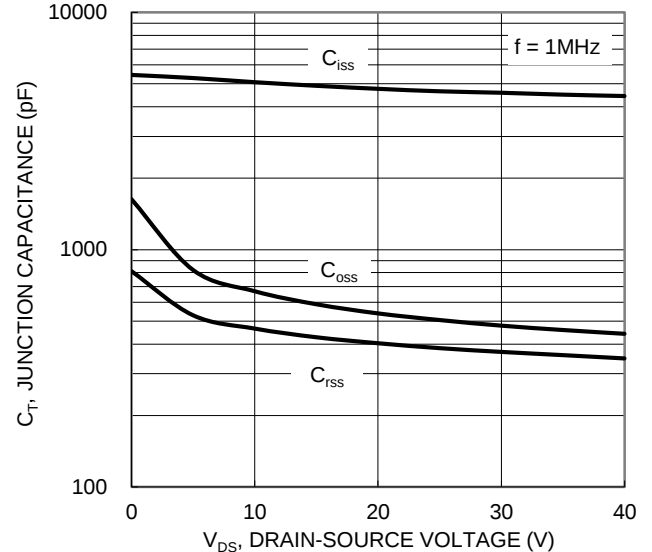


Figure 10. Typical Junction Capacitance

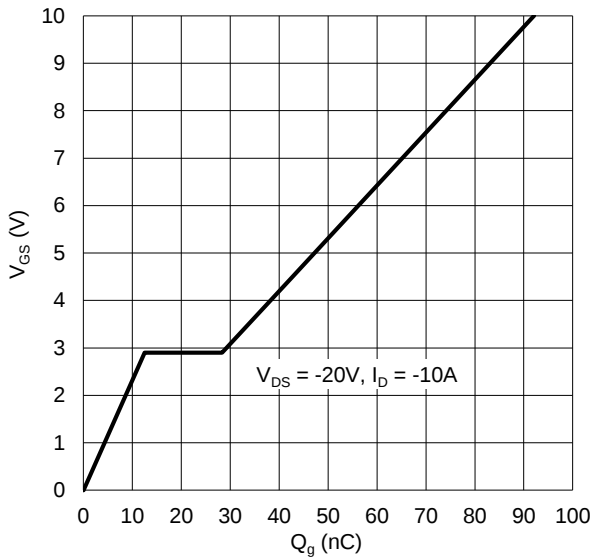


Figure 11. Gate Charge

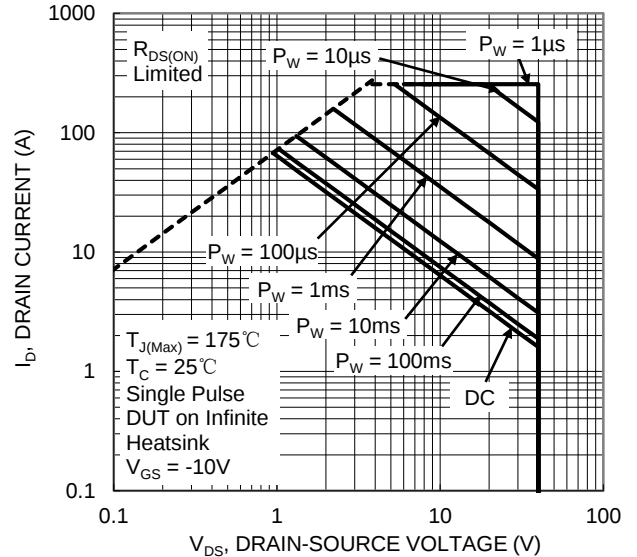


Figure 12. SOA, Safe Operation Area

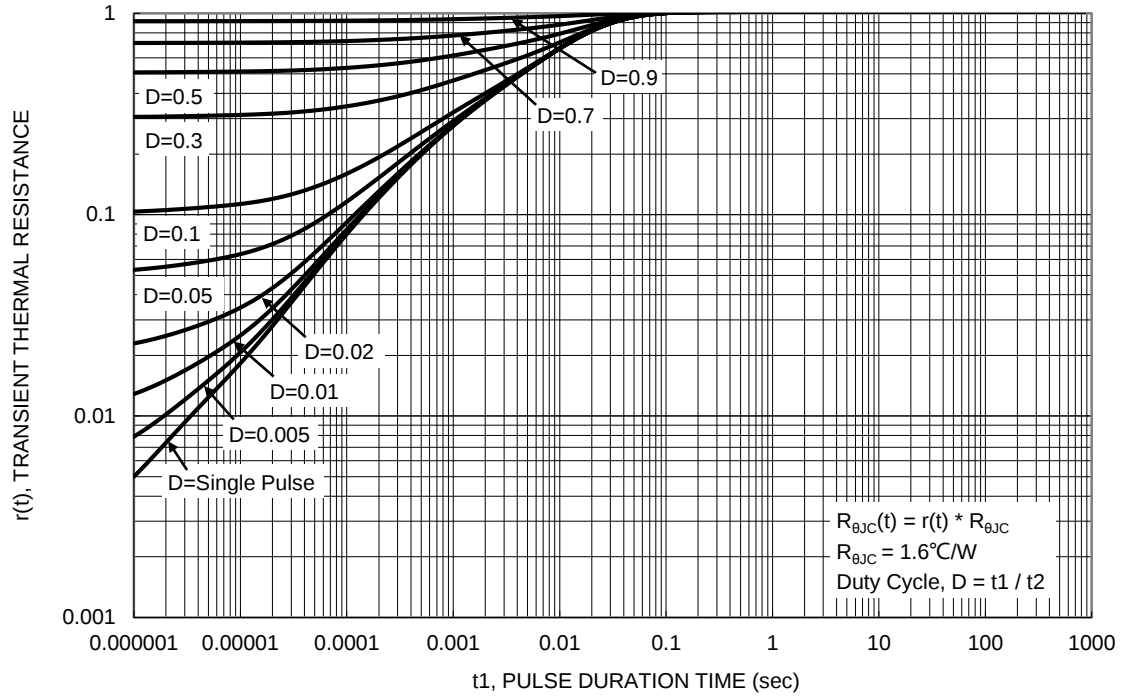
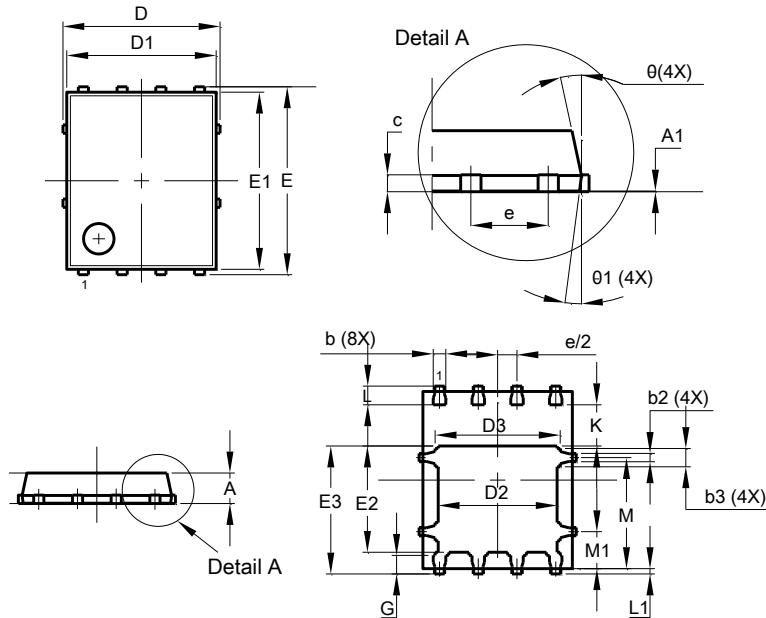


Figure 13. Transient Thermal Resistance

Package Outline Dimensions

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

PowerDI5060-8

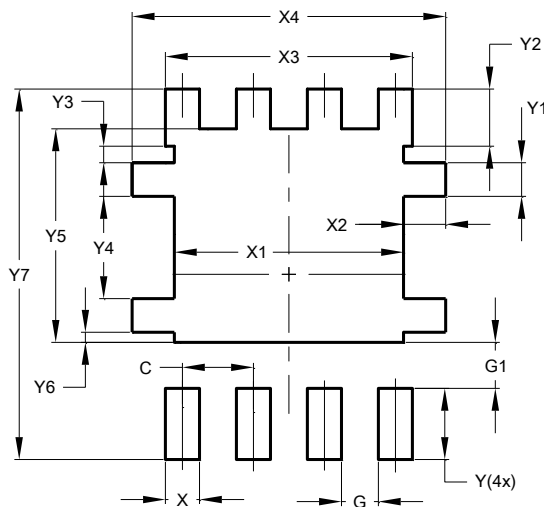


PowerDI5060-8			
Dim	Min	Max	Typ
A	0.90	1.10	1.00
A1	0.00	0.05	—
b	0.33	0.51	0.41
b2	0.200	0.350	0.273
b3	0.40	0.80	0.60
c	0.230	0.330	0.277
D	5.15 BSC		
D1	4.70	5.10	4.90
D2	3.70	4.10	3.90
D3	3.90	4.30	4.10
E	6.15 BSC		
E1	5.60	6.00	5.80
E2	3.28	3.68	3.48
E3	3.99	4.39	4.19
e	1.27 BSC		
G	0.51	0.71	0.61
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°
$\theta1$	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



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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