40V 175°C DUAL N-CHANNEL ENHANCEMENT MODE MOSFET

Product Summary

BV$_{DSS}$	R$_{DS(ON)}$ Max	I$_D$ Max T$_C$ = +25°C
40V	12.3mΩ @ V$_{GS}$ = 10V	46.2A
	17.5mΩ @ V$_{GS}$ = 4.5V	38.7A

Description and Applications

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.

- Power Management Functions
- DC-DC Converters

Features and Benefits

- Rated to +175°C – Ideal for High Ambient Temperature Environments
- 100% Unclamped Inductive Switching, Test in Production– 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)**
- **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 or your local Diodes representative.**
  https://www.diodes.com/quality/product-definitions/
- **An Automotive-Compliant Part is Available Under Separate Datasheet (DMTH4008LPDWQ)**

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 — Matte Tin Annealed over Copper Leadframe. Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.097 grams (Approximate)

PowerDI5060-8/SWP (Type UXD)

Top View   Bottom View

Pin Out (Top View)

Equivalent Circuit
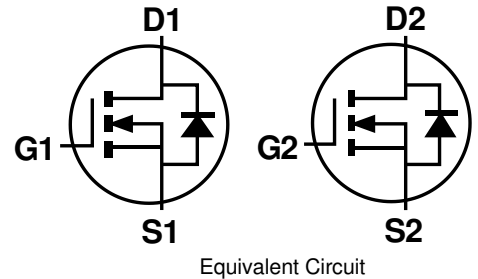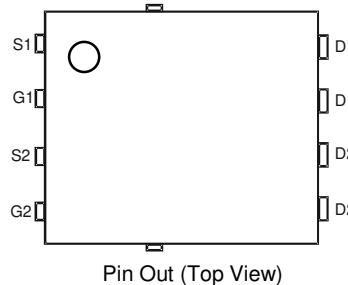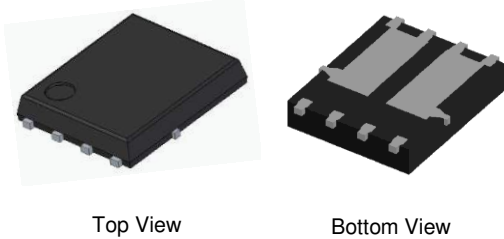
Ordering Information (Note 4)

Part Number	Case	Packaging
DMTH4008LPDW-13	PowerDI5060-8/SWP (Type UXD)	2,500/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. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.

Marking Information
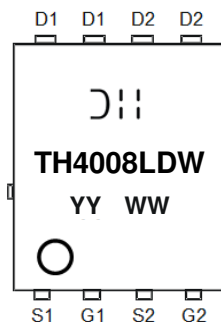
TH4008LDW

⊃¦¦ = Manufacturer's Marking
TH4008LDW = Product Type Marking Code
YYWW or $\overline{YY}$WW = Date Code Marking
YY or $\overline{YY}$ = Year (ex: 20 = 2020)
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$_{DSS}$	40	V
Gate-Source Voltage		V$_{GSS}$	±20	V
Continuous Drain Current (Note 5)	T$_A$ = +25°C	I$_D$	10.0	A
	T$_A$ = +100°C		7.1	
Continuous Drain Current (Note 6)	T$_C$ = +25°C	I$_D$	46.2	A
	T$_C$ = +100°C		32.7	
Pulsed Drain Current (10µs Pulse, Duty Cycle = 1%)		I$_{DM}$	184	A
Maximum Continuous Body Diode Forward Current (Note 6)		I$_S$	43.7	A
Pulsed Body Diode Forward Current (10µs Pulse, Duty Cycle = 1%)		I$_{SM}$	184	A
Avalanche Current, L = 0.1mH		I$_{AS}$	23.1	A
Avalanche Energy, L = 0.1mH		E$_{AS}$	26.6	mJ

Thermal Characteristics

Characteristic		Symbol	Value	Unit
Total Power Dissipation (Note 5)	T$_A$ = +25°C	P$_D$	2.67	W
Thermal Resistance, Junction to Ambient (Note 5)		R$_{θJA}$	56.6	°C/W
Total Power Dissipation (Note 6)	T$_C$ = +25°C	P$_D$	39.4	W
Thermal Resistance, Junction to Case (Note 6)		R$_{θJC}$	3.8	°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 7)						
Drain-Source Breakdown Voltage	BV$_{DSS}$	40	—	—	V	V$_{GS}$ = 0V, I$_D$ = 250µA
Zero Gate Voltage Drain Current	I$_{DSS}$	—	—	1	µA	V$_{DS}$ = 32V, V$_{GS}$ = 0V
Gate-Source Leakage	I$_{GSS}$	—	—	±100	nA	V$_{GS}$ = ±20V, V$_{DS}$ = 0V
ON CHARACTERISTICS (Note 7)						
Gate Threshold Voltage	V$_{GS(TH)}$	1.2	1.88	2.3	V	V$_{DS}$ = V$_{GS}$, I$_D$ = 250µA
Static Drain-Source On-Resistance	R$_{DS(ON)}$	—	9.5	12.3	mΩ	V$_{GS}$ = 10V, I$_D$ = 20A
		—	11.9	17.5	mΩ	V$_{GS}$ = 4.5V, I$_D$ = 10A
Diode Forward Voltage	V$_{SD}$	—	0.9	1.2	V	V$_{GS}$ = 0V, I$_S$ = 20A
DYNAMIC CHARACTERISTICS (Note 8)						
Input Capacitance	C$_{iss}$	—	881	—	pF	V$_{DS}$ = 20V, V$_{GS}$ = 0V, f = 1MHz
Output Capacitance	C$_{oss}$	—	496	—	pF	
Reverse Transfer Capacitance	C$_{rss}$	—	19.5	—	pF	
Gate Resistance	R$_g$	—	2.06	—	Ω	V$_{DS}$ = 0V, V$_{GS}$ = 0V, f = 1MHz
Total Gate Charge (V$_{GS}$ = 10V)	Q$_g$	—	12.3	—	nC	V$_{DS}$ = 20V, I$_D$ = 20A
Total Gate Charge (V$_{GS}$ = 4.5V)	Q$_g$	—	5.8	—	nC	
Gate-Source Charge	Q$_{gs}$	—	2.6	—	nC	
Gate-Drain Charge	Q$_{gd}$	—	1.6	—	nC	
Turn-On Delay Time	t$_{D(ON)}$	—	3.82	—	ns	V$_{DD}$ = 20V, V$_{GS}$ = 10V, R$_g$ = 3Ω, I$_D$ = 20A
Turn-On Rise Time	t$_R$	—	4.76	—	ns	
Turn-Off Delay Time	t$_{D(OFF)}$	—	12.6	—	ns	
Turn-Off Fall Time	t$_F$	—	4.83	—	ns	
Body Diode Reverse Recovery Time	t$_{RR}$	—	31.9	—	ns	I$_F$ = 20A, di/dt = 100A/µs
Body Diode Reverse Recovery Charge	Q$_{RR}$	—	25.0	—	nC	

Notes: 5. Device mounted on FR-4 substrate PC board, 2oz. copper, with thermal bias to bottom layer 1inch square copper plate.
6. Thermal resistance from junction to soldering point (on the exposed drain pad).
7. Short duration pulse test used to minimize self-heating effect.
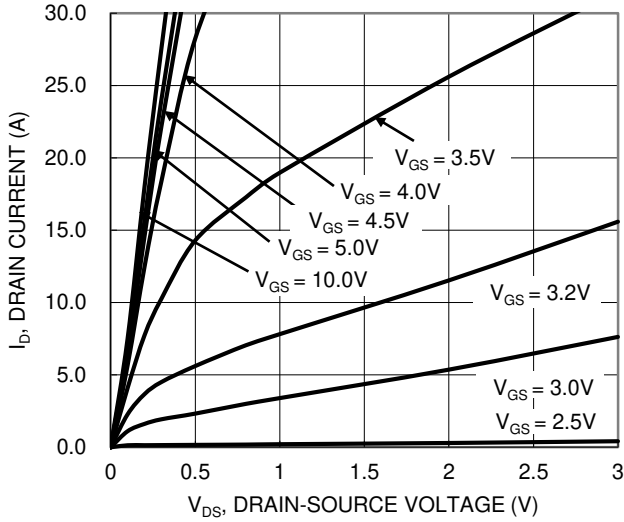8. Guaranteed by design. Not subject to product testing.

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Figure 1. Typical Output Characteristic

V_{GS} = 3.5V
V_{GS} = 4.0V
V_{GS} = 4.5V
V_{GS} = 5.0V
V_{GS} = 10.0V
V_{GS} = 3.2V
V_{GS} = 3.0V
V_{GS} = 2.5V

I_D, DRAIN CURRENT (A)
V_{DS}, DRAIN-SOURCE VOLTAGE (V)
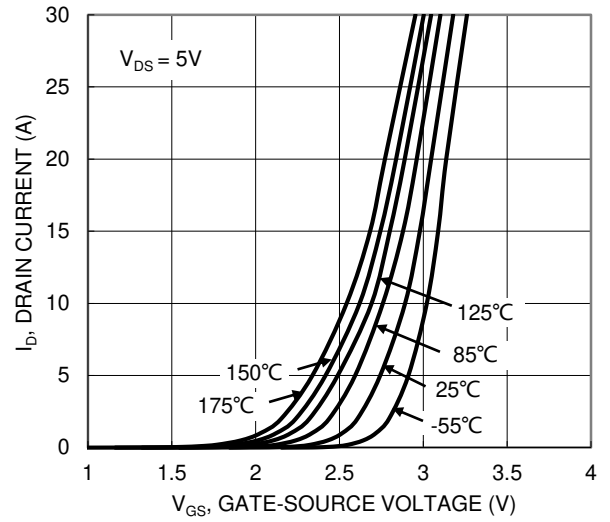
Figure 2. Typical Transfer Characteristic

V_{DS} = 5V
125℃
85℃
150℃
25℃
175℃
-55℃

I_D, DRAIN CURRENT (A)
V_{GS}, GATE-SOURCE VOLTAGE (V)
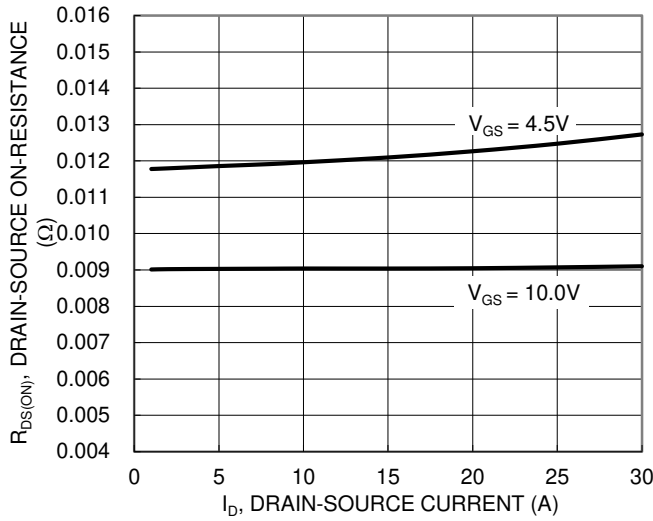
Figure 3. Typical On-Resistance vs. Drain Current and Gate Voltage

V_{GS} = 4.5V
V_{GS} = 10.0V

$R_{DS(ON)}$, DRAIN-SOURCE ON-RESISTANCE (Ω)
I_D, DRAIN-SOURCE CURRENT (A)
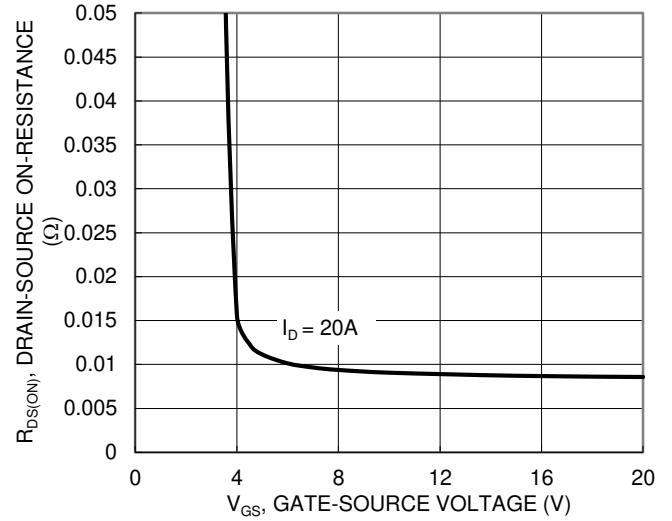
Figure 4. Typical Transfer Characteristic

I_D = 20A

$R_{DS(ON)}$, DRAIN-SOURCE ON-RESISTANCE (Ω)
V_{GS}, GATE-SOURCE VOLTAGE (V)
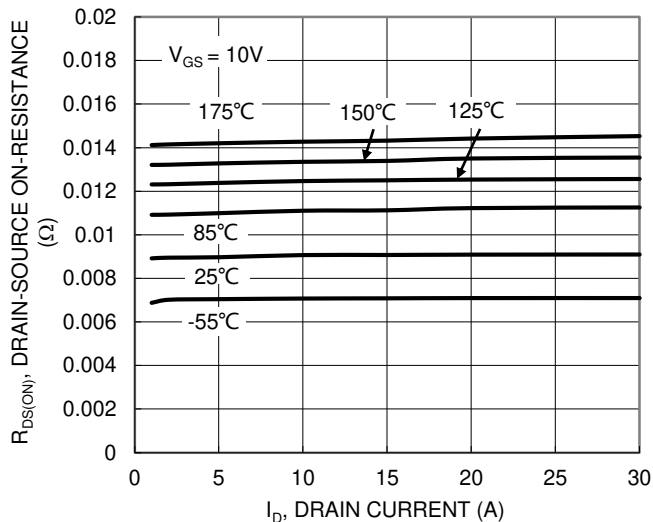
Figure 5. Typical On-Resistance vs. Drain Current and Temperature

V_{GS} = 10V
175℃
150℃
125℃
85℃
25℃
-55℃

$R_{DS(ON)}$, DRAIN-SOURCE ON-RESISTANCE (Ω)
I_D, DRAIN CURRENT (A)
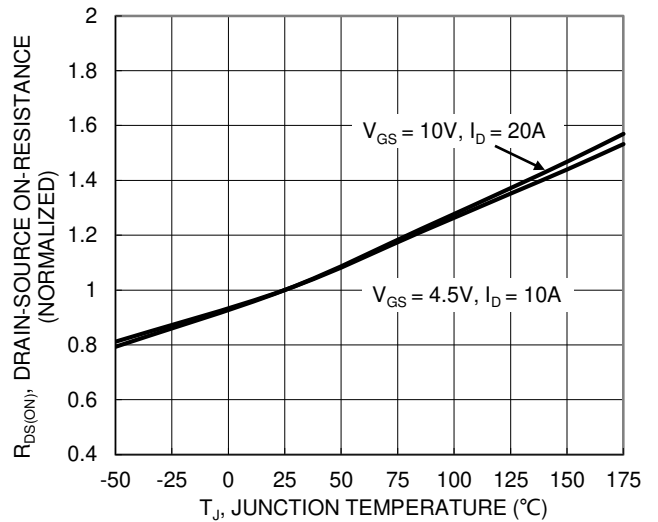
Figure 6. On-Resistance Variation with Temperature

V_{GS} = 10V, I_D = 20A
V_{GS} = 4.5V, I_D = 10A

$R_{DS(ON)}$, DRAIN-SOURCE ON-RESISTANCE (NORMALIZED)
T_J, JUNCTION TEMPERATURE (℃)

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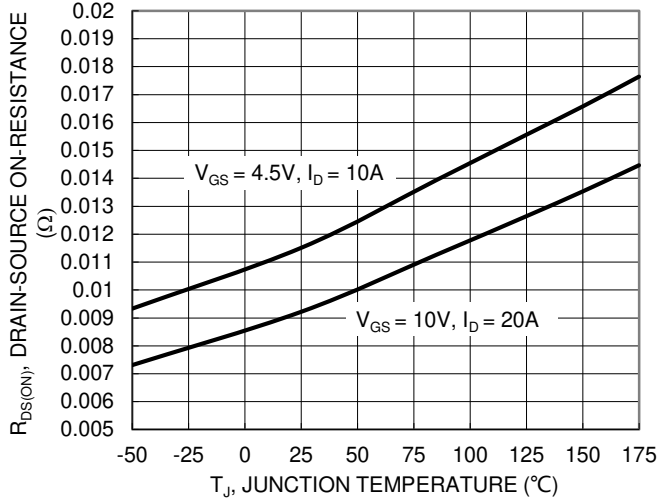May 2020
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Figure 7. On-Resistance Variation with Temperature
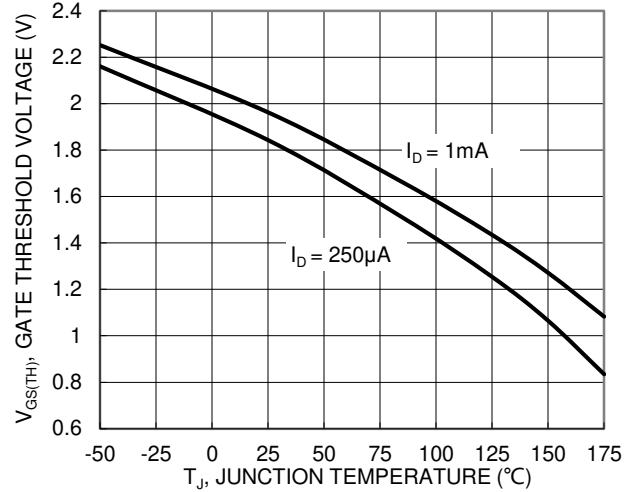

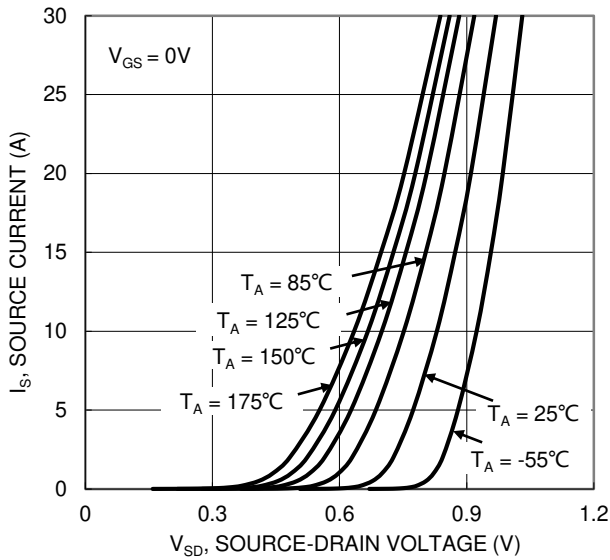Figure 8. Gate Threshold Variation vs. Junction Temperature
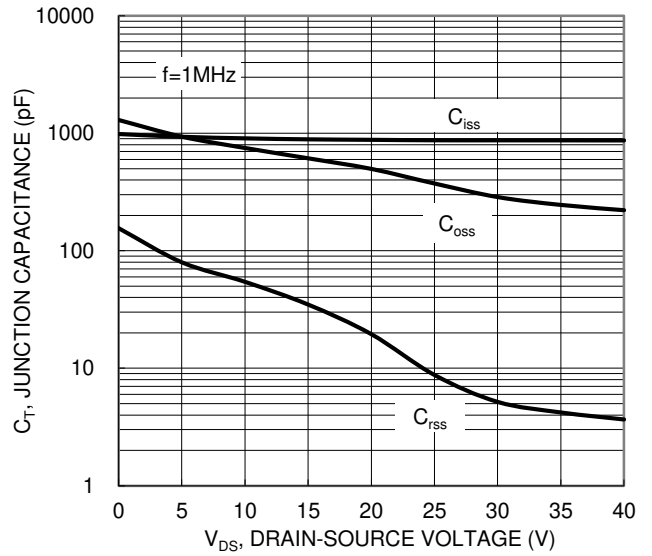

Figure 9. Diode Forward Voltage vs. Current
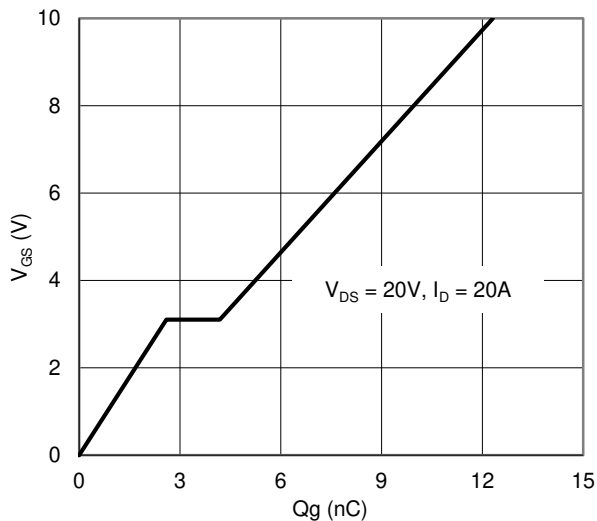

Figure 10. Typical Junction Capacitance

Figure 11. Gate Charge
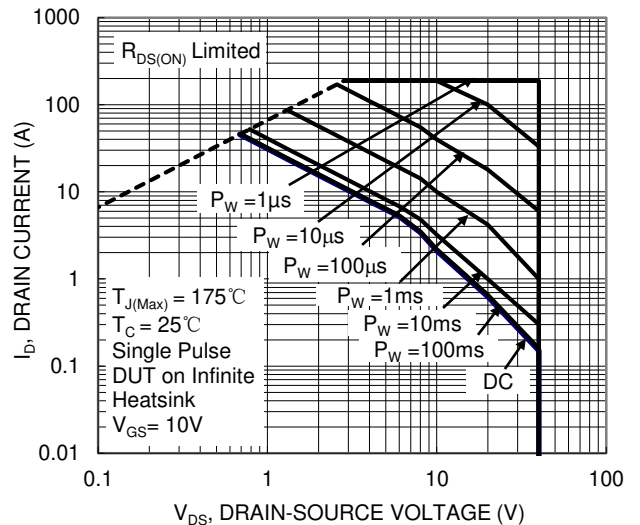
Figure 12. SOA, Safe Operation Area

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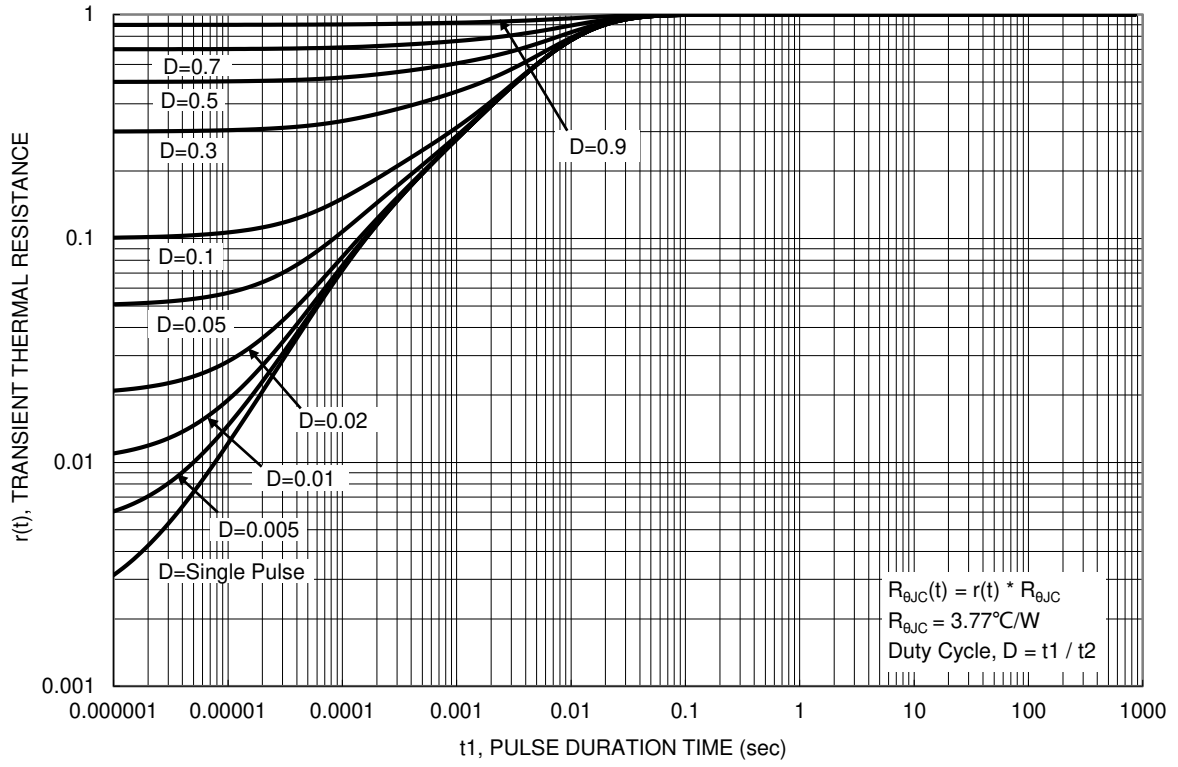
Figure 13. Transient Thermal Resistance

The graph shows r(t), TRANSIENT THERMAL RESISTANCE versus t1, PULSE DURATION TIME (sec), with curves for:
- D=0.9
- D=0.7
- D=0.5
- D=0.3
- D=0.1
- D=0.05
- D=0.02
- D=0.01
- D=0.005
- D=Single Pulse

$R_{\theta JC}(t) = r(t) * R_{\theta JC}$
$R_{\theta JC} = 3.77°C/W$
Duty Cycle, $D = t1 / t2$

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Package Outline Dimensions

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

PowerDI5060-8/SWP (Type UXD)

DETAIL A

Ø1.000 Depth 0.07±0.030

DETAIL A
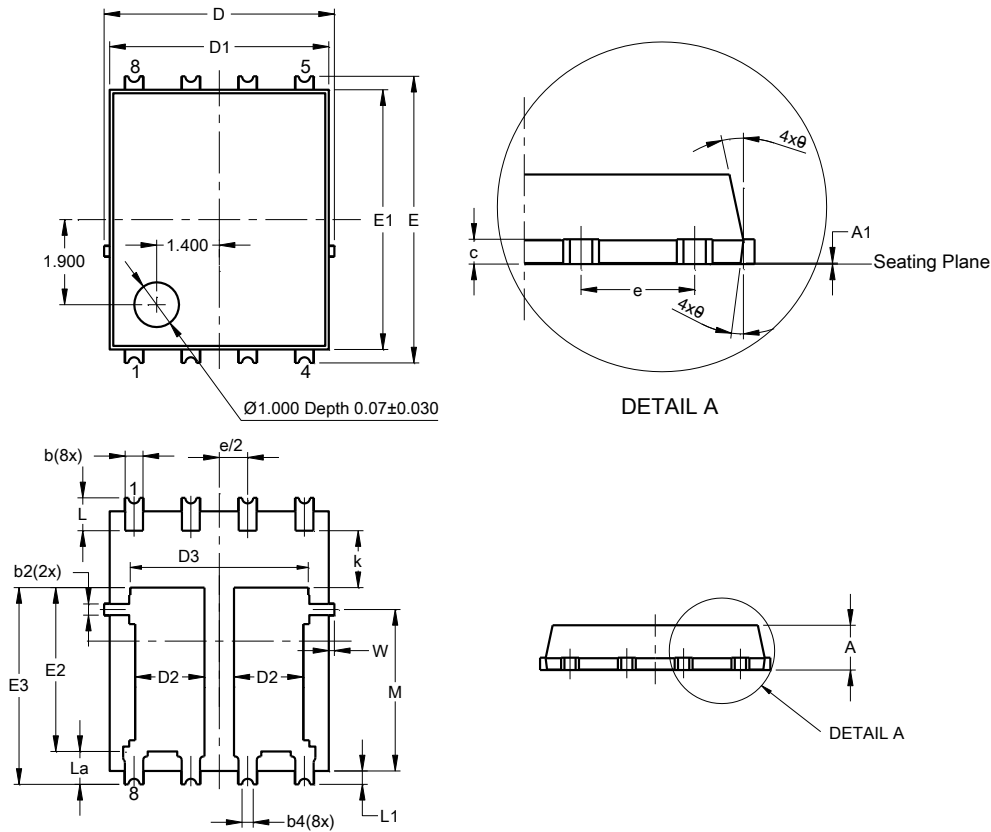
PowerDI5060-8/SWP (Type UXD)			
Dim	Min	Max	Typ
A	0.90	1.10	1.00
A1	0.00	0.05	--
b	0.30	0.50	0.41
b2	0.20	0.35	0.25
b4	0.25REF		
c	0.230	0.330	0.277
D	5.15 BSC		
D1	4.70	5.10	4.90
D2	1.46	1.66	1.55
D3	3.78	4.18	3.98
E	6.40 BSC		
E1	5.60	6.00	5.80
E2	3.46	3.86	3.66
E2a	4.195	4.595	4.395
e	1.27BSC		
k	1.05	--	--
L	0.635	0.835	0.735
La	0.635	0.835	0.735
L1	0.200	0.400	0.300
M	3.205	4.005	3.605
W	0.025	0.225	0.125
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 UXD)
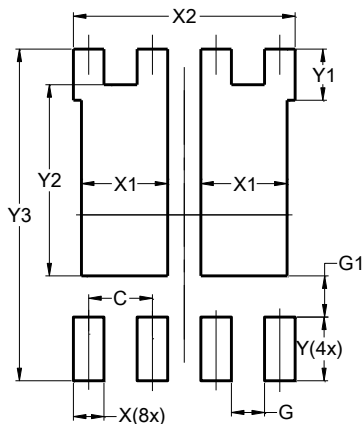
Dimensions	Value (in mm)
C	1.270
G	0.660
G1	0.820
X	0.610
X1	1.720
X2	4.420
Y	1.270
Y1	1.020
Y2	3.810
Y3	6.610

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