

**Product Summary**

Device	V <sub>(BR)DSS</sub>	R <sub>DS(ON)</sub>	I <sub>D</sub> T <sub>A</sub> = +25°C
Q1	12V	17mΩ @ V <sub>GS</sub> = 4.5V	9.5A
		25mΩ @ V <sub>GS</sub> = 2.5V	7.8A
Q2	-20V	20mΩ @ V <sub>GS</sub> = -4.5V	-8.7A
		25mΩ @ V <sub>GS</sub> = -2.5V	-7.8A

**Description and Applications**

This new generation Complementary Pair Enhancement Mode MOSFET has been designed to minimize R<sub>DS(ON)</sub> and yet maintain superior switching performance. This device is ideal for use in Notebook battery power management and Loadswitch.

- Notebook Battery Power Management
- DC-DC Converters
- Loadswitch

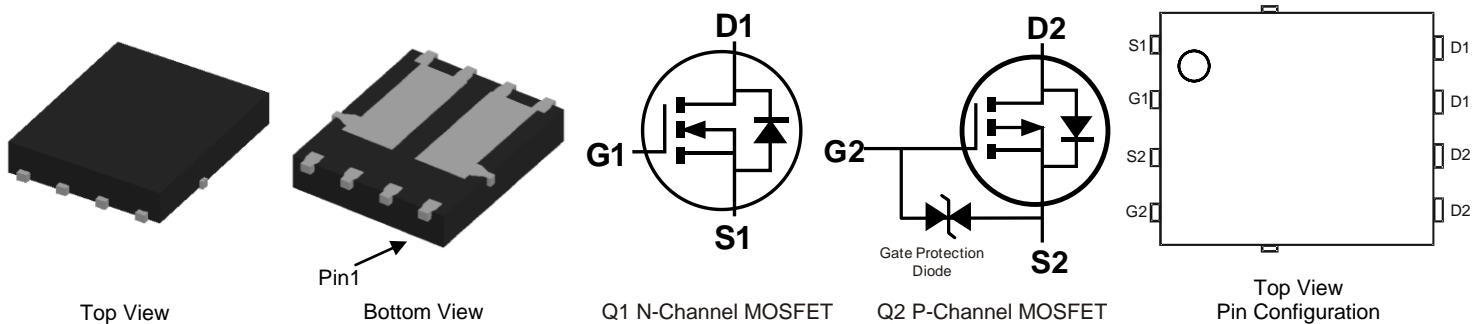
**Features and Benefits**

- Thermally Efficient Package-Cooler Running Applications
- High Conversion Efficiency
- Low R<sub>DS(ON)</sub> – Minimizes On State Losses
- Low Input Capacitance
- Fast Switching Speed
- **ESD Protected Gate for Q2 P-Channel**
- **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-Q101, PPAP capable, and manufactured in IATF 16949 certified facilities), please refer to the related automotive grade (Q-suffix) part. A listing can be found at <https://www.diodes.com/products/automotive/automotive-products/>.**
- **This part is qualified to JEDEC standards (as references in AEC-Q101) for High Reliability. <https://www.diodes.com/quality/product-definitions/>**

**Mechanical Data**

- Case: PowerDI<sup>®</sup>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)
- Terminal Connections: See Diagram Below
- Weight: 0.097 grams (Approximate)

PowerDI5060-8 (Type C)

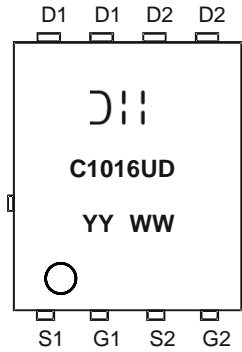


**Ordering Information** (Note 4)

Part Number	Case	Packaging
DMC1016UPD-13	PowerDI5060-8 (Type C)	2500 / 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 <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



D $\bar{}$ || = Manufacturer's Marking  
 C1016UD = Product Type Marking Code  
 YYWW = Date Code Marking  
 YY = Year (ex: 16 = 2016)  
 WW = Week (01 to 53)

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

Characteristic		Symbol	Q1 Value	Q2 Value	Units	
Drain-Source Voltage		V <sub>DSS</sub>	12	-20	V	
Gate-Source Voltage		V <sub>GSS</sub>	±8	±8	V	
Continuous Drain Current (Note 5) V <sub>GS</sub> = 4.5V	Steady State	I <sub>D</sub>	T <sub>A</sub> = +25°C T <sub>A</sub> = +70°C	9.5 7.6	-8.7 -7.0	A
	t < 10s		T <sub>A</sub> = +25°C T <sub>A</sub> = +70°C	13.0 10.4	-12.0 -9.6	A
Maximum Body Diode Forward Current (Note 5)		I <sub>S</sub>	2.6	-2.6	A	
Pulsed Drain Current (10µs pulse, duty cycle = 1%)		I <sub>DM</sub>	65	-60	A	
Avalanche Current (Note 6) L = 0.1mH		I <sub>AS</sub>	20	-27	A	
Avalanche Energy (Note 6) L = 0.1mH		E <sub>AS</sub>	25	38	mJ	

## Thermal Characteristics

Characteristic	Symbol	Value	Units
Total Power Dissipation (Note 5)	P <sub>D</sub>	T <sub>A</sub> = +25°C	2.3
		T <sub>A</sub> = +70°C	1.5
Thermal Resistance, Junction to Ambient (Note 5)	R <sub>θJA</sub>	Steady state	55
		t < 10s	29
Thermal Resistance, Junction to Case	R <sub>θJC</sub>	6.2	°C/W
Operating and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-55 to +150	

Notes: 5. Device mounted on FR-4 substrate PC board, 2oz copper, with 1inch square copper plate.  
 6. I<sub>AS</sub> and E<sub>AS</sub> rating are based on low frequency and duty cycles to keep T<sub>J</sub> = +25°C.

**Electrical Characteristics Q1 N-Channel** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS (Note 7)</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	12	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
Zero Gate Voltage Drain Current	$I_{DSS}$	—	—	1	$\mu A$	$V_{DS} = 12V, V_{GS} = 0V$
Gate-Source Leakage	$I_{GSS}$	—	—	$\pm 100$	nA	$V_{GS} = \pm 8V, V_{DS} = 0V$
<b>ON CHARACTERISTICS (Note 7)</b>						
Gate Threshold Voltage	$V_{GS(TH)}$	0.6	0.8	1.5	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
Static Drain-Source On-Resistance	$R_{DS(ON)}$	—	9.0	17	m $\Omega$	$V_{GS} = 4.5V, I_D = 11.8A$
		—	11	25		$V_{GS} = 2.5V, I_D = 9.8A$
Diode Forward Voltage	$V_{SD}$	—	0.7	1.2	V	$V_{GS} = 0V, I_S = 2.9A$
<b>DYNAMIC CHARACTERISTICS (Note 8)</b>						
Input Capacitance	$C_{iss}$	—	1454	—	pF	$V_{DS} = 6V, V_{GS} = 0V, f = 1.0MHz$
Output Capacitance	$C_{oss}$	—	336	—		
Reverse Transfer Capacitance	$C_{riss}$	—	311	—		
Gate Resistance	$R_G$	—	1.6	—	$\Omega$	$V_{DS} = 0V, V_{GS} = 0V, f = 1.0MHz$
Total Gate Charge ( $V_{GS} = 4.5V$ )	$Q_g$	—	18	—	nC	$V_{DS} = 6V, I_D = 11.8A$
Total Gate Charge ( $V_{GS} = 8V$ )	$Q_g$	—	32	—		
Gate-Source Charge	$Q_{gs}$	—	3.1	—		
Gate-Drain Charge	$Q_{gd}$	—	4.3	—		
Turn-On Delay Time	$t_{D(ON)}$	—	6.6	—	ns	$V_{DD} = 6V, R_L = 6\Omega, V_{GS} = 4.5V, R_G = 6\Omega, I_D = 1A$
Turn-On Rise Time	$t_R$	—	9.6	—		
Turn-Off Delay Time	$t_{D(OFF)}$	—	42.5	—		
Turn-Off Fall Time	$t_F$	—	22.5	—		
Body Diode Reverse Recovery Time	$t_{RR}$	—	16.6	—	ns	$I_F = 11.8A, di/dt = 100A/\mu s$
Body Diode Reverse Recovery Charge	$Q_{RR}$	—	2.8	—	nC	$I_F = 11.8A, di/dt = 100A/\mu s$

Notes: 7. Short duration pulse test used to minimize self-heating effect.  
8. Guaranteed by design. Not subject to product testing.

**Electrical Characteristics Q2 P-Channel** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS (Note 7)</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	-20	—	—	V	$V_{GS} = 0V, I_D = -250\mu A$
Zero Gate Voltage Drain Current	$I_{DSS}$	—	—	-1	$\mu A$	$V_{DS} = -20V, V_{GS} = 0V$
Gate-Source Leakage	$I_{GSS}$	—	—	$\pm 10$	$\mu A$	$V_{GS} = \pm 8V, V_{DS} = 0V$
<b>ON CHARACTERISTICS (Note 7)</b>						
Gate Threshold Voltage	$V_{GS(TH)}$	-0.35	-0.6	-1.0	V	$V_{DS} = V_{GS}, I_D = -250\mu A$
Static Drain-Source On-Resistance	$R_{DS(ON)}$	—	14	20	m $\Omega$	$V_{GS} = -4.5V, I_D = -7.0A$
		—	17	25		$V_{GS} = -2.5V, I_D = -5.0A$
		—	22	40		$V_{GS} = -1.8V, I_D = -3.0A$
		—	26	80		$V_{GS} = -1.5V, I_D = -1.0A$
Diode Forward Voltage	$V_{SD}$	—	-0.8	-1.2	V	$V_{GS} = 0V, I_S = -1.0A$
<b>DYNAMIC CHARACTERISTICS (Note 8)</b>						
Input Capacitance	$C_{ISS}$	—	3103	—	pF	$V_{DS} = -15V, V_{GS} = 0V, f = 1.0MHz$
Output Capacitance	$C_{OSS}$	—	351	—		
Reverse Transfer Capacitance	$C_{RSS}$	—	239	—		
Gate Resistance	$R_G$	—	12	—	$\Omega$	$V_{DS} = 0V, V_{GS} = 0V, f = 1.0MHz$
Total Gate Charge ( $V_{GS} = -4.5V$ )	$Q_g$	—	32	—	nC	$V_{DS} = -6V, I_D = -8.9A$
Total Gate Charge ( $V_{GS} = -8V$ )	$Q_g$	—	56	—		
Gate-Source Charge	$Q_{gs}$	—	4.5	—		
Gate-Drain Charge	$Q_{gd}$	—	6.1	—		
Turn-On Delay Time	$t_{D(ON)}$	—	8.1	—	ns	$V_{DD} = -6V, R_L = 6\Omega, V_{GS} = -4.5V, R_G = 6\Omega, I_D = -1A$
Turn-On Rise Time	$t_R$	—	16.0	—		
Turn-Off Delay Time	$t_{D(OFF)}$	—	150	—		
Turn-Off Fall Time	$t_F$	—	82	—		
Body Diode Reverse Recovery Time	$t_{RR}$	—	20.6	—	ns	$I_F = -8.9A, di/dt = -100A/\mu s$
Body Diode Reverse Recovery Charge	$Q_{RR}$	—	8.3	—	nC	$I_F = -8.9A, di/dt = -100A/\mu s$

Notes: 7. Short duration pulse test used to minimize self-heating effect.  
8. Guaranteed by design. Not subject to product testing.

**Typical Characteristics - N-CHANNEL**

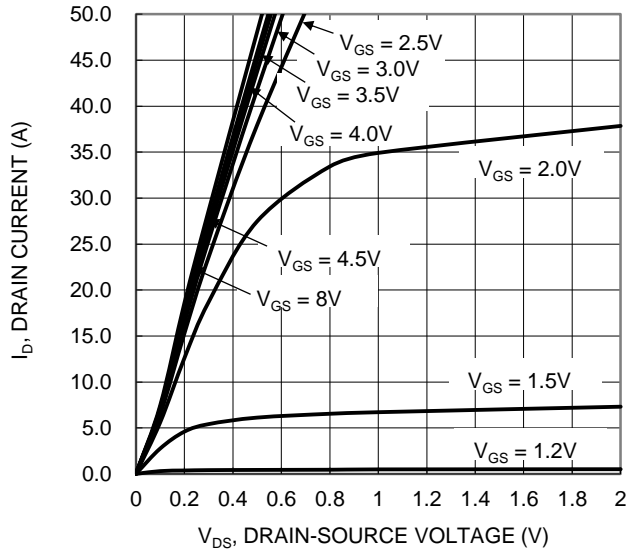


Figure 1. Typical Output Characteristic

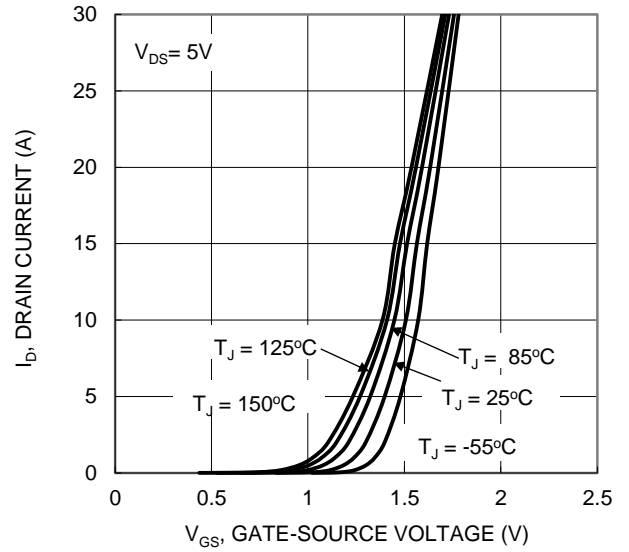


Figure 2. Typical Transfer Characteristic

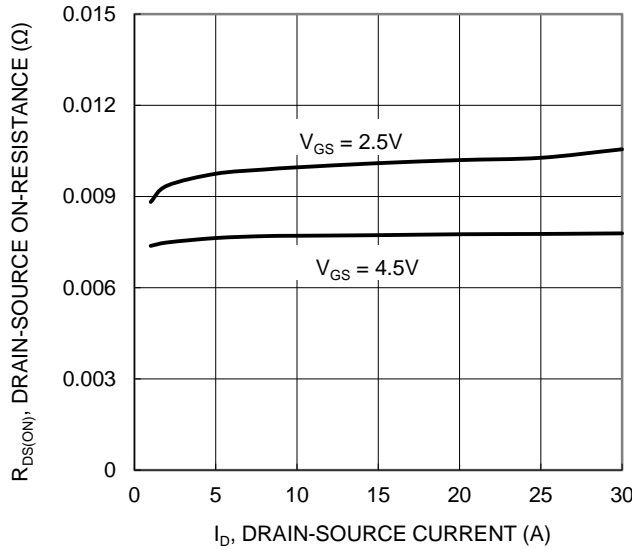


Figure 3. Typical On-Resistance vs Drain Current and Gate Voltage

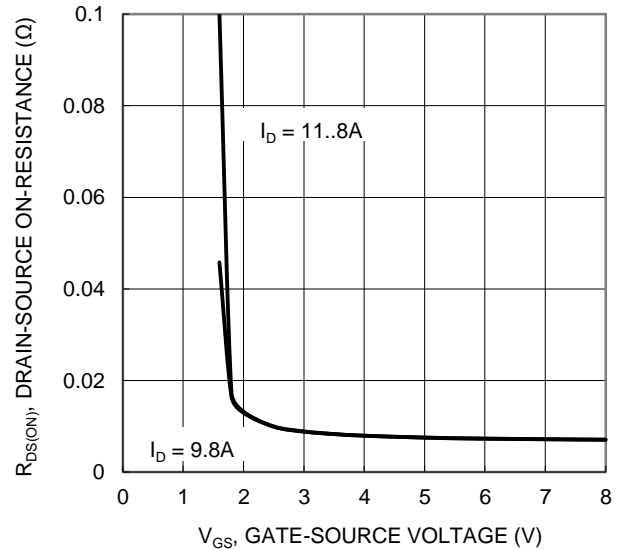


Figure 4. Typical Transfer Characteristic

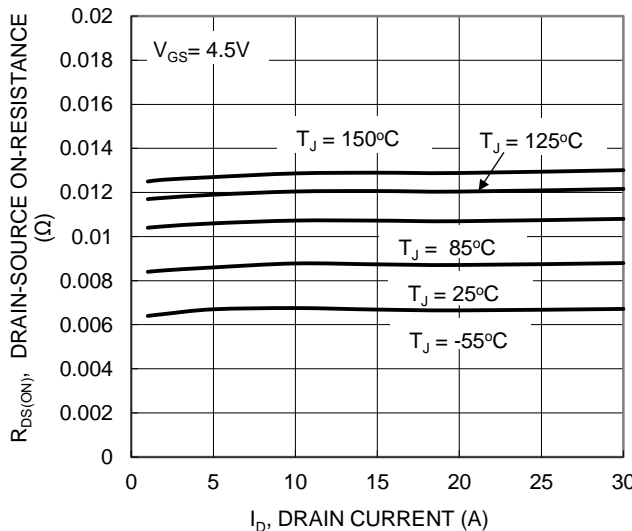


Figure 5. Typical On-Resistance vs Drain Current and Temperature

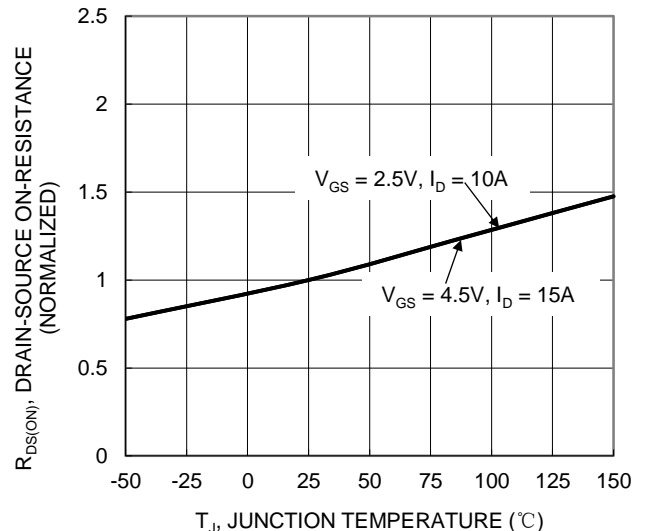
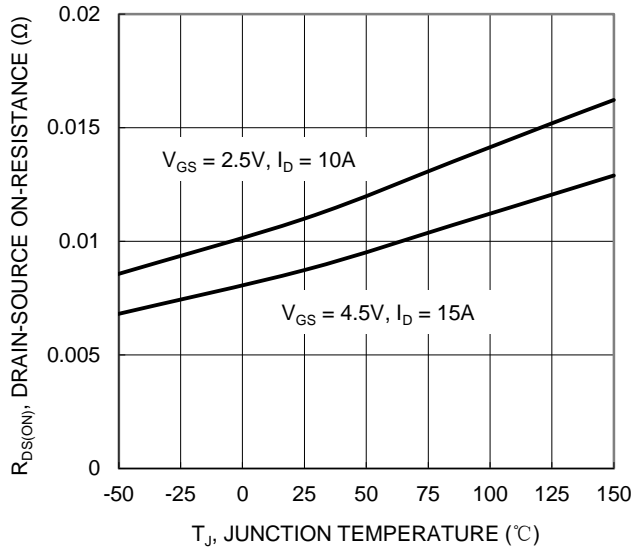
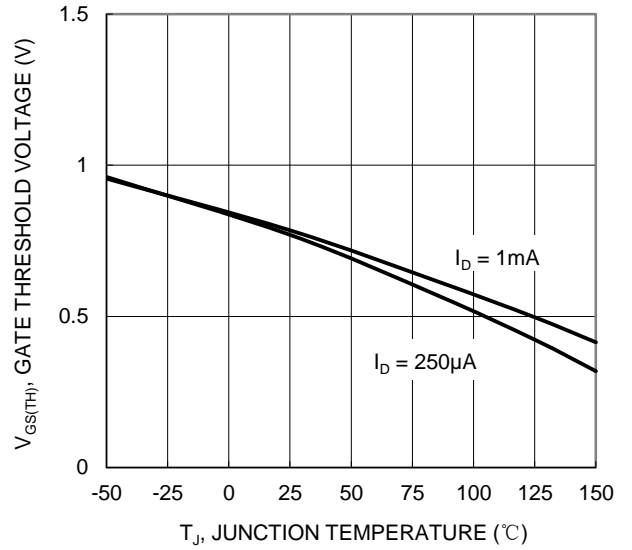


Figure 6. On-Resistance Variation with Junction Temperature

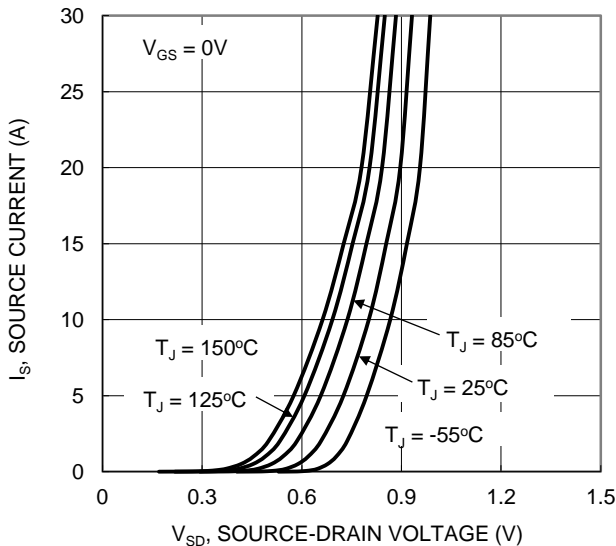
**Typical Characteristics - N-CHANNEL (Cont.)**



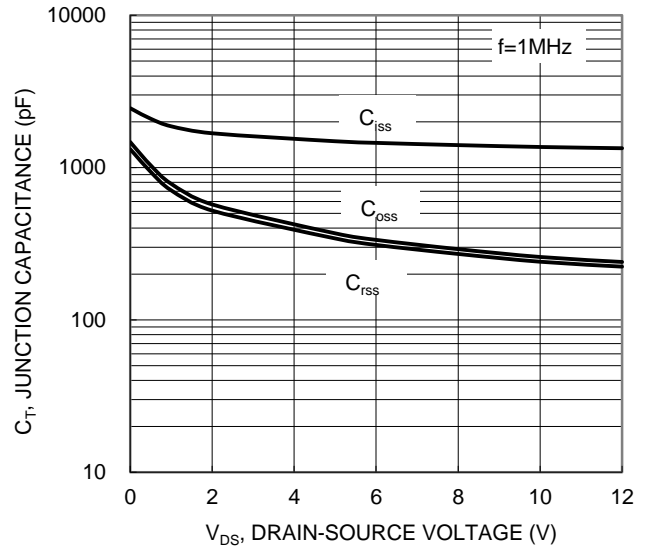
T<sub>J</sub>, JUNCTION TEMPERATURE (°C)  
Figure 7. On-Resistance Variation with Junction Temperature



T<sub>J</sub>, JUNCTION TEMPERATURE (°C)  
Figure 8. Gate Threshold Variation vs Junction Temperature



V<sub>SD</sub>, SOURCE-DRAIN VOLTAGE (V)  
Figure 9. Diode Forward Voltage vs. Current



V<sub>DS</sub>, DRAIN-SOURCE VOLTAGE (V)  
Figure 10. Typical Junction Capacitance

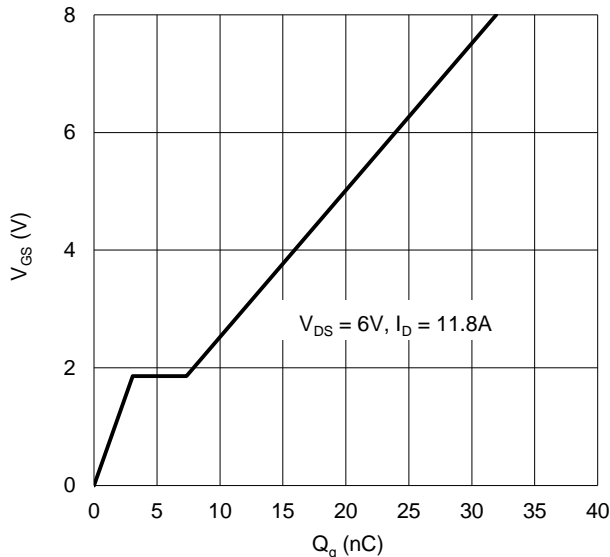
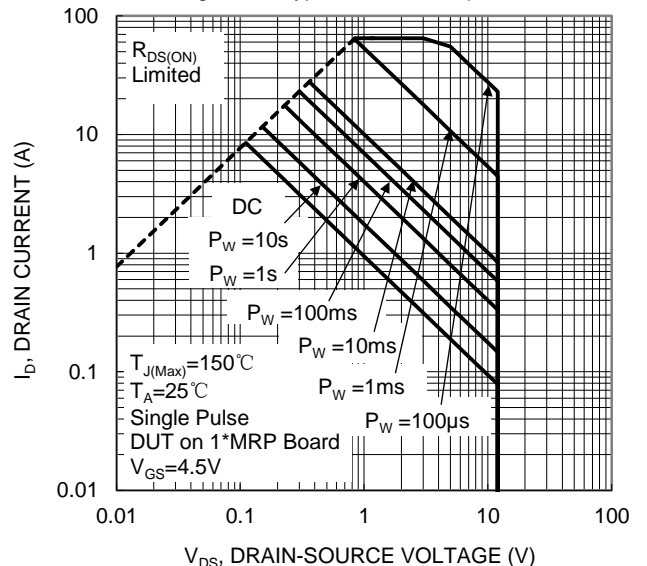


Figure 11. Gate Charge



V<sub>DS</sub>, DRAIN-SOURCE VOLTAGE (V)  
Figure 12. SOA, Safe Operation Area

**Typical Characteristics - P-CHANNEL**

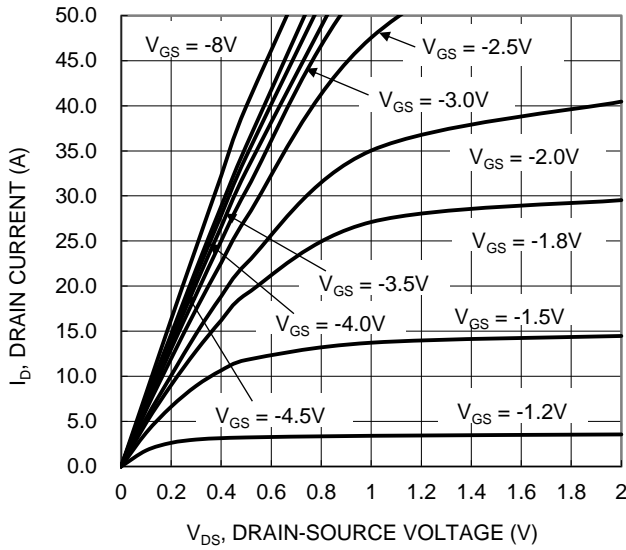


Figure 13. Typical Output Characteristic

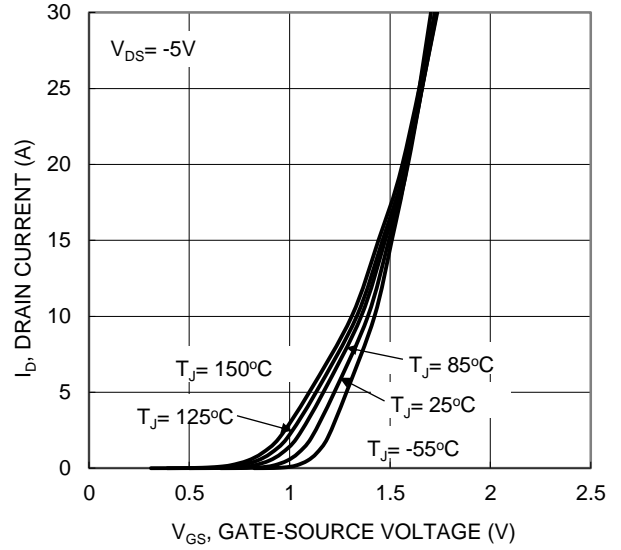


Figure 14. Typical Transfer Characteristic

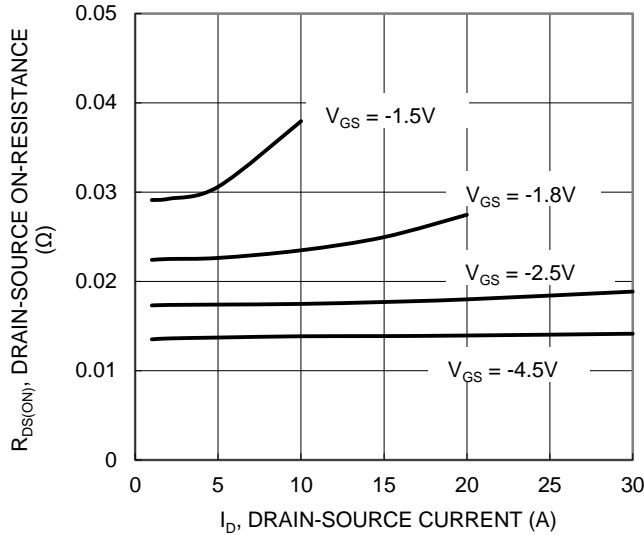


Figure 15. Typical On-Resistance vs Drain Current and Gate Voltage

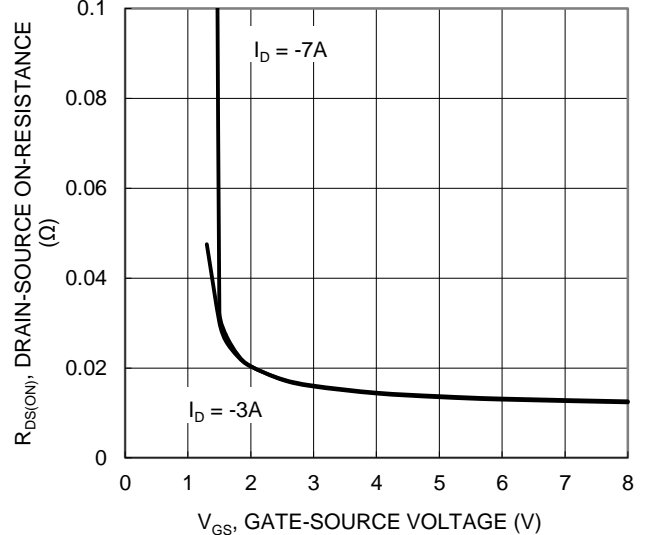


Figure 16. Typical Transfer Characteristic

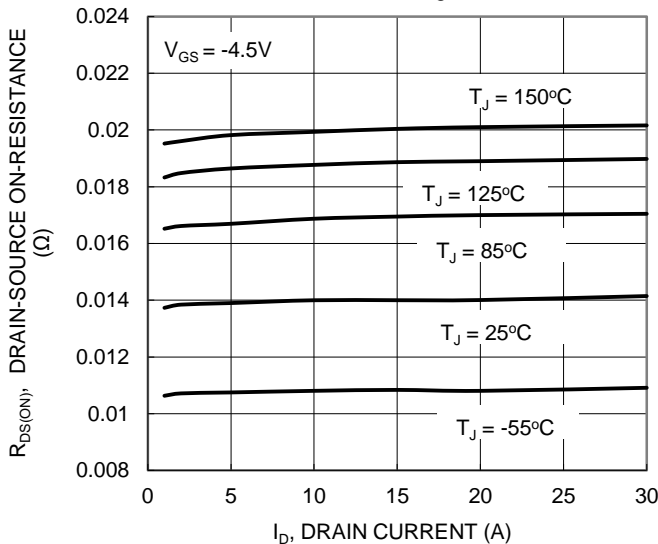


Figure 17. Typical On-Resistance vs Drain Current and Temperature

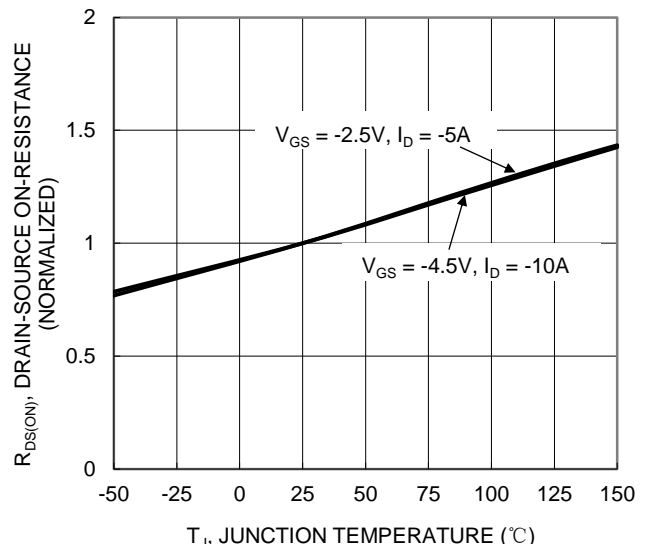
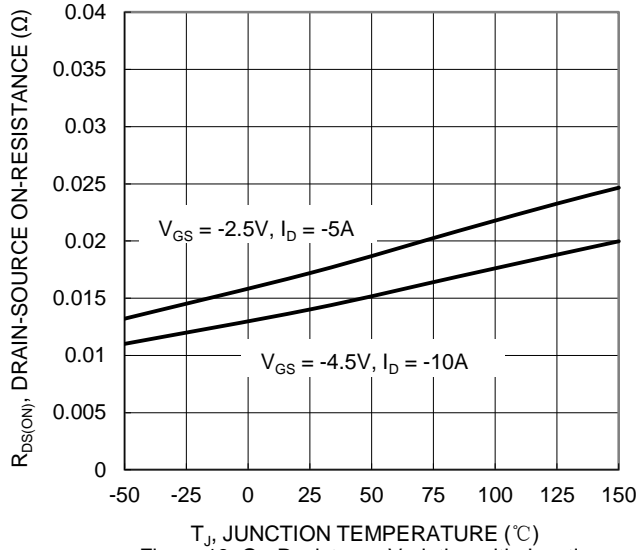
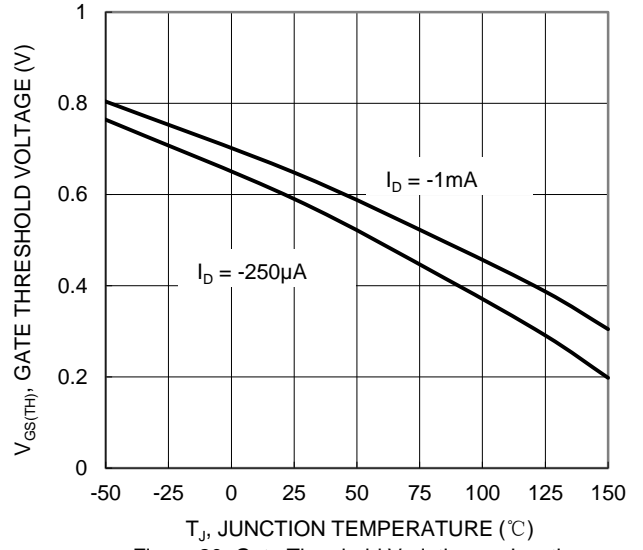


Figure 18. On-Resistance Variation with junction Temperature

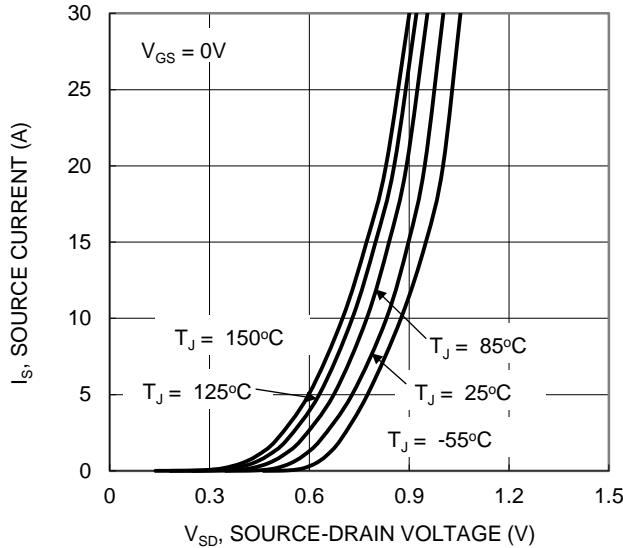
**Typical Characteristics - P-CHANNEL (Cont.)**



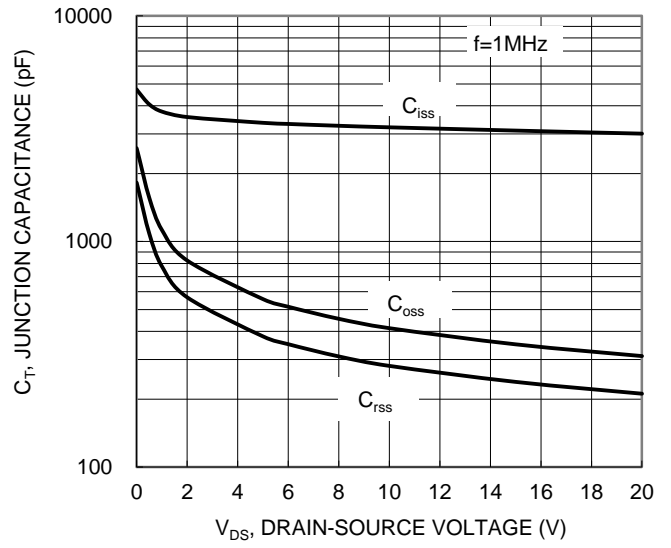
T<sub>J</sub>, JUNCTION TEMPERATURE (°C)  
Figure 19. On-Resistance Variation with Junction Temperature



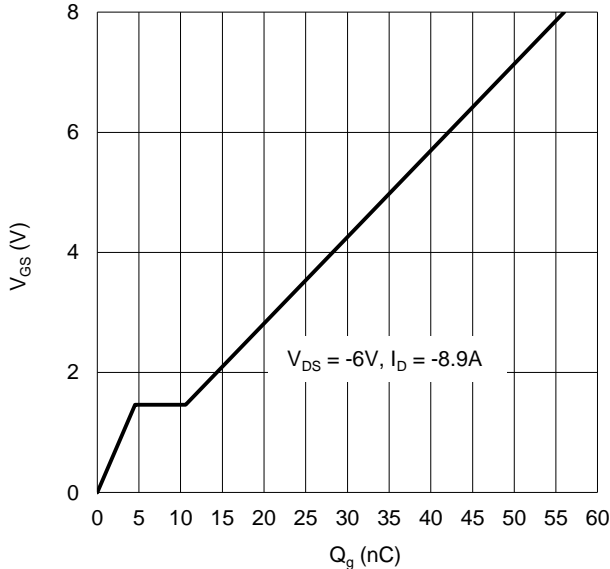
T<sub>J</sub>, JUNCTION TEMPERATURE (°C)  
Figure 20. Gate Threshold Variation vs Junction Temperature



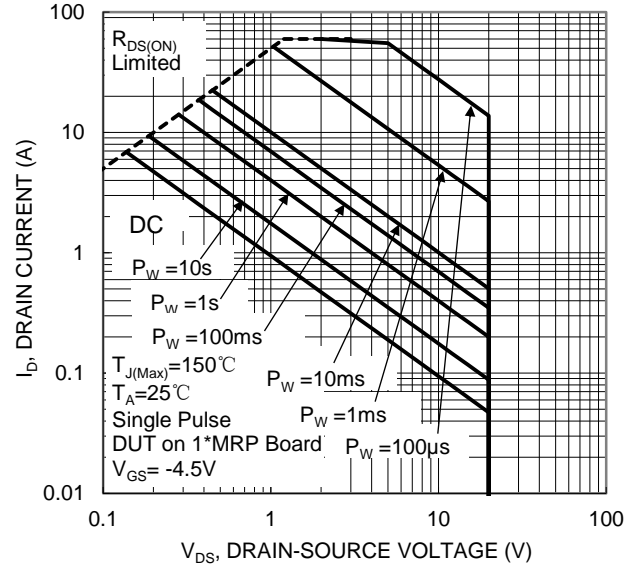
V<sub>SD</sub>, SOURCE-DRAIN VOLTAGE (V)  
Figure 21. Diode Forward Voltage vs. Current



V<sub>DS</sub>, DRAIN-SOURCE VOLTAGE (V)  
Figure 22. Typical Junction Capacitance



Q<sub>g</sub> (nC)  
Figure 23. Gate Charge



V<sub>DS</sub>, DRAIN-SOURCE VOLTAGE (V)  
Figure 24. SOA, Safe Operation Area



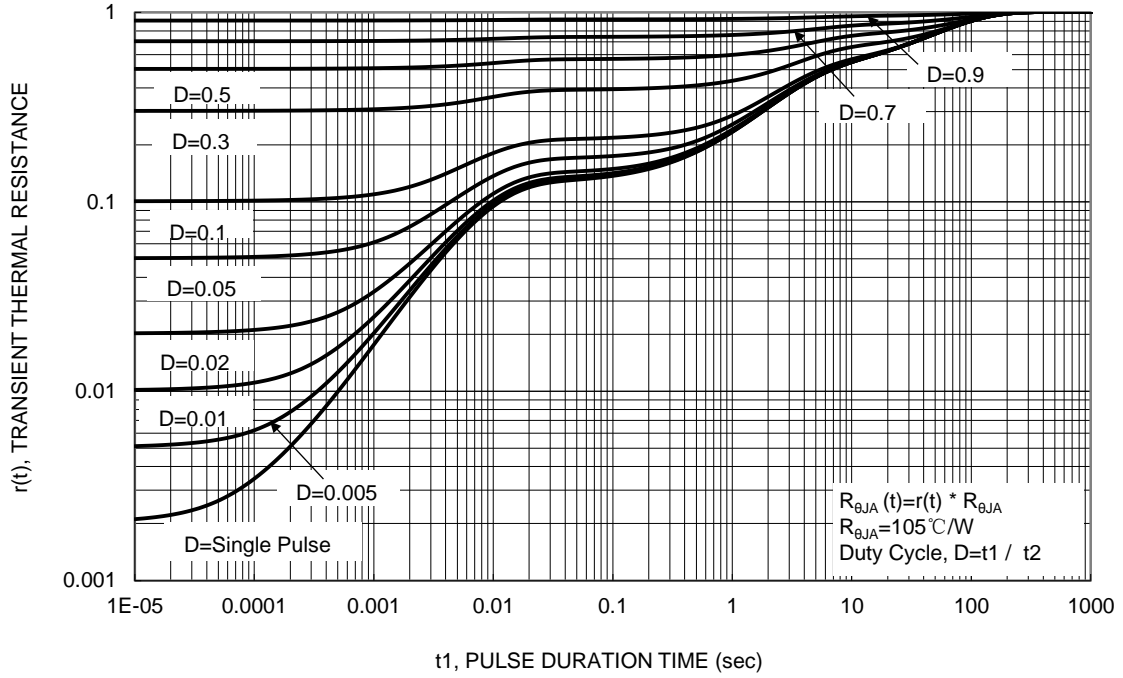
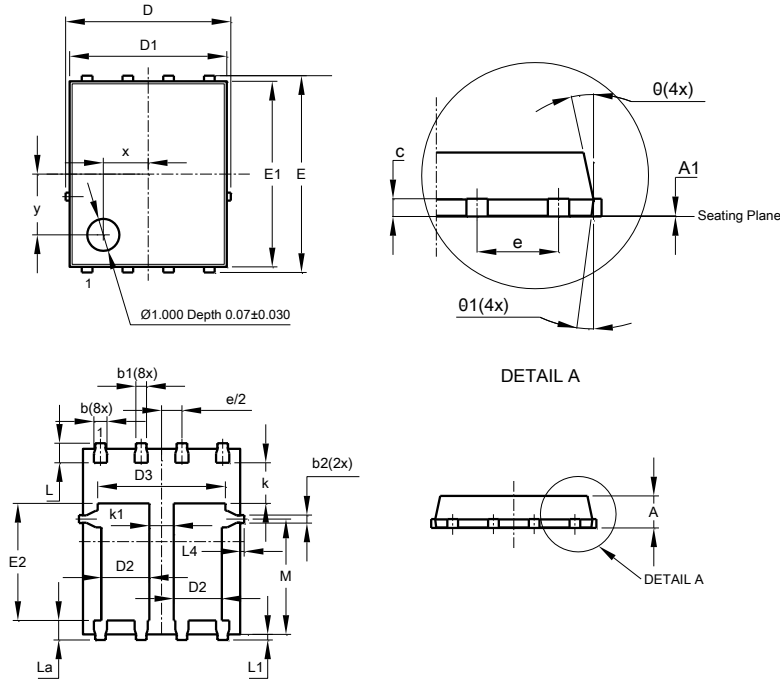


Figure 25. Transient Thermal Resistance

**Package Outline Dimensions**

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

**PowerDI5060-8 (Type C)**

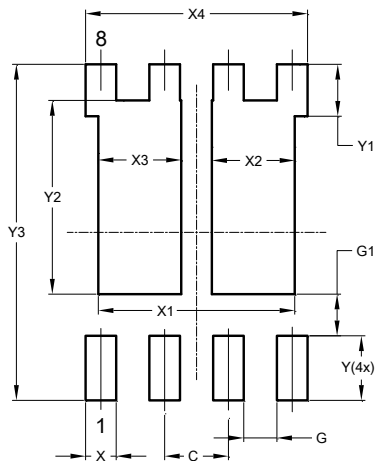


PowerDI5060-8 (Type C)			
Dim	Min	Max	Typ
A	0.90	1.10	1.00
A1	0	0.05	0.02
b	0.33	0.51	0.41
b1	0.300	0.366	0.333
b2	0.20	0.35	0.25
c	0.23	0.33	0.277
D	5.15 BSC		
D1	4.85	4.95	4.90
D2	1.40	1.60	1.50
D3	-	-	3.98
E	6.15 BSC		
E1	5.75	5.85	5.80
E2	3.56	3.76	3.66
e	1.27BSC		
k	-	-	1.27
k1	0.56	-	-
L	0.51	0.71	0.61
La	0.51	0.71	0.61
L1	0.05	0.20	0.175
L4	-	-	0.125
M	3.50	3.71	3.605
x	-	-	1.400
y	-	-	1.900
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 (Type C)**



Dimensions	Value (in mm)
C	1.270
G	0.660
G1	0.820
X	0.610
X1	3.910
X2	1.650
X3	1.650
X4	4.420
Y	1.270
Y1	1.020
Y2	3.810
Y3	6.610

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2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

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