

**COMPLEMENTARY PAIR ENHANCEMENT MODE MOSFET  
POWERDI**

**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

**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)**
- **Qualified to AEC-Q101 Standards for High Reliability**

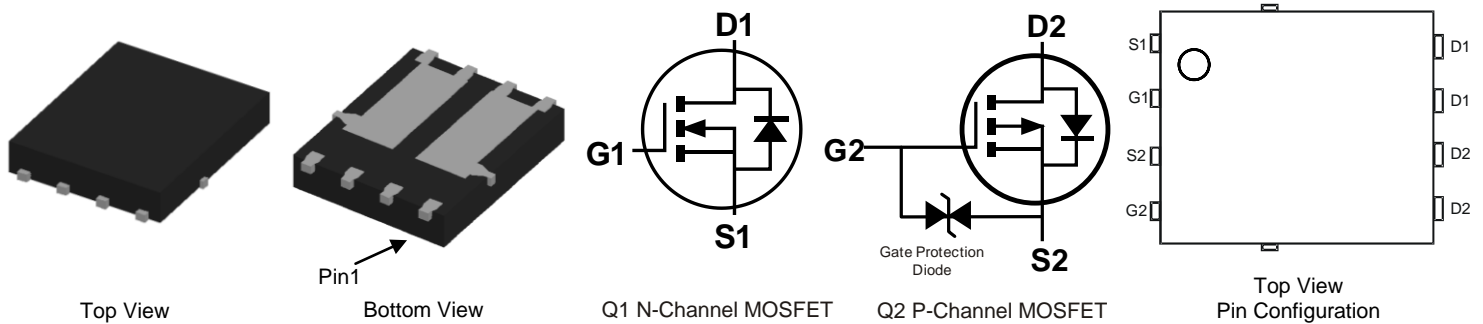
**Description and Applications**

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

**Mechanical Data**

- Case: PowerDI5060-8 (Type C)
- 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)

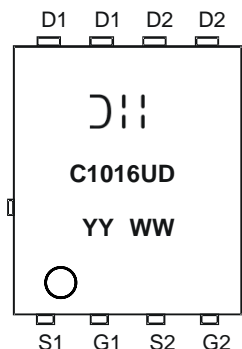


**Ordering Information (Note 4)**

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) compliant.
  2. 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.
  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 <http://www.diodes.com/products/packages.html>.

**Marking Information**



☺☺☺ = Manufacturer's Marking  
 C1016UD = Product Type Marking Code  
 YYWW = Date Code Marking  
 YY = Year (ex: 16 = 2016)  
 WW = Week (01 - 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	T <sub>A</sub> = +25°C T <sub>A</sub> = +70°C	I <sub>D</sub>	9.5 7.6	-8.7 -7.0	A
	t < 10s	T <sub>A</sub> = +25°C T <sub>A</sub> = +70°C	I <sub>D</sub>	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)	T <sub>A</sub> = +25°C	P <sub>D</sub>	2.3	W
	T <sub>A</sub> = +70°C		1.5	
Thermal Resistance, Junction to Ambient (Note 5)	Steady state	R <sub>θJA</sub>	55	°C/W
	t < 10s		29	
Thermal Resistance, Junction to Case		R <sub>θJC</sub>	6.2	
Operating and Storage Temperature Range		T <sub>J</sub> , T <sub>STG</sub>	-55 to +150	°C

**Electrical Characteristics Q1 N-Channel** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
<b>OFF CHARACTERISTICS (Note 7)</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	12	—	—	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> = 12V, V <sub>GS</sub> = 0V
Gate-Source Leakage	I <sub>GSS</sub>	—	—	±100	nA	V <sub>GS</sub> = ±8V, V <sub>DS</sub> = 0V
<b>ON CHARACTERISTICS (Note 7)</b>						
Gate Threshold Voltage	V <sub>GS(TH)</sub>	0.6	0.8	1.5	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250µA
Static Drain-Source On-Resistance	R <sub>DS(ON)</sub>	—	9.0	17	mΩ	V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 11.8A
		—	11	25		V <sub>GS</sub> = 2.5V, I <sub>D</sub> = 9.8A
Diode Forward Voltage	V <sub>SD</sub>	—	0.7	1.2	V	V <sub>GS</sub> = 0V, I <sub>S</sub> = 2.9A
<b>DYNAMIC CHARACTERISTICS (Note 8)</b>						
Input Capacitance	C <sub>iss</sub>	—	1454	—	pF	V <sub>DS</sub> = 6V, V <sub>GS</sub> = 0V, f = 1.0MHz
Output Capacitance	C <sub>oss</sub>	—	336	—		
Reverse Transfer Capacitance	C <sub>rss</sub>	—	311	—		
Gate Resistance	R <sub>G</sub>	—	1.6	—	Ω	V <sub>DS</sub> = 0V, V <sub>GS</sub> = 0V, f = 1.0MHz
Total Gate Charge (V <sub>GS</sub> = 4.5V)	Q <sub>g</sub>	—	18	—	nC	V <sub>DS</sub> = 6V, I <sub>D</sub> = 11.8A
Total Gate Charge (V <sub>GS</sub> = 8V)	Q <sub>g</sub>	—	32	—		
Gate-Source Charge	Q <sub>gs</sub>	—	3.1	—		
Gate-Drain Charge	Q <sub>gd</sub>	—	4.3	—		
Turn-On Delay Time	t <sub>D(ON)</sub>	—	6.6	—	ns	V <sub>DD</sub> = 6V, R <sub>L</sub> = 6Ω V <sub>GS</sub> = 4.5V, R <sub>G</sub> = 6Ω, I <sub>D</sub> = 1A
Turn-On Rise Time	t <sub>R</sub>	—	9.6	—		
Turn-Off Delay Time	t <sub>D(OFF)</sub>	—	42.5	—		
Turn-Off Fall Time	t <sub>F</sub>	—	22.5	—		
Body Diode Reverse Recovery Time	t <sub>RR</sub>	—	16.6	—	ns	I <sub>F</sub> = 11.8A, di/dt = 100A/µs
Body Diode Reverse Recovery Charge	Q <sub>RR</sub>	—	2.8	—	nC	I <sub>F</sub> = 11.8A, di/dt = 100A/µs

**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:
5. Device mounted on FR-4 substrate PC board, 2oz copper, with 1inch square copper plate.
  6.  $I_{AS}$  and  $E_{AS}$  rating are based on low frequency and duty cycles to keep  $T_J = +25^\circ\text{C}$ .
  7. Short duration pulse test used to minimize self-heating effect.
  8. Guaranteed by design. Not subject to product testing.

**Typical Characteristics - N-CHANNEL**

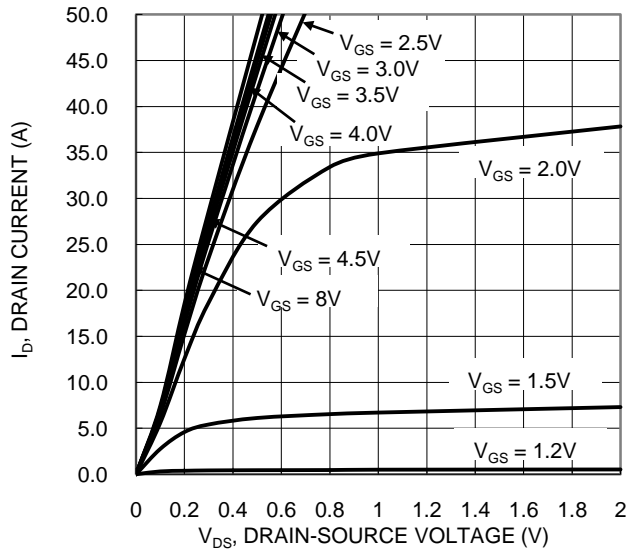


Figure 1. Typical Output Characteristic

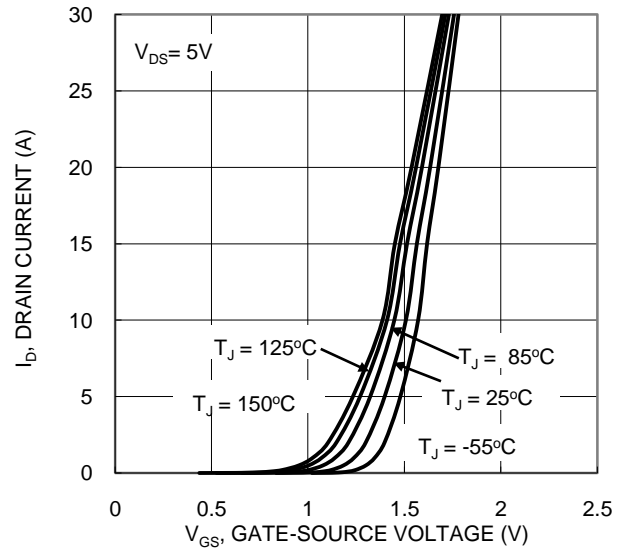


Figure 2. Typical Transfer Characteristic

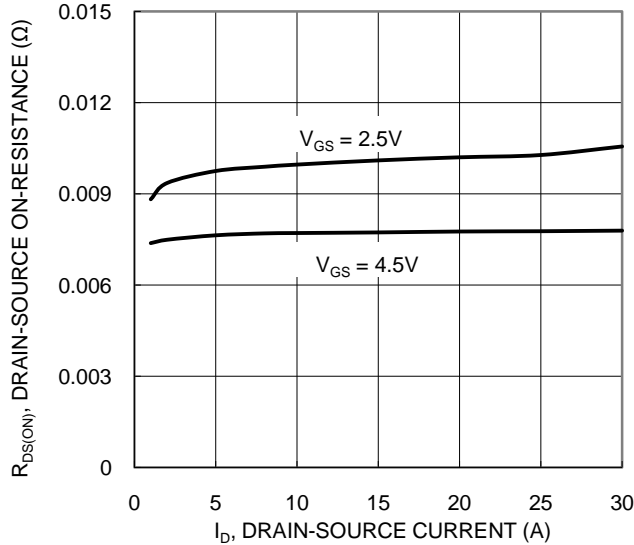


Figure 3. Typical On-Resistance vs Drain Current and Gate Voltage

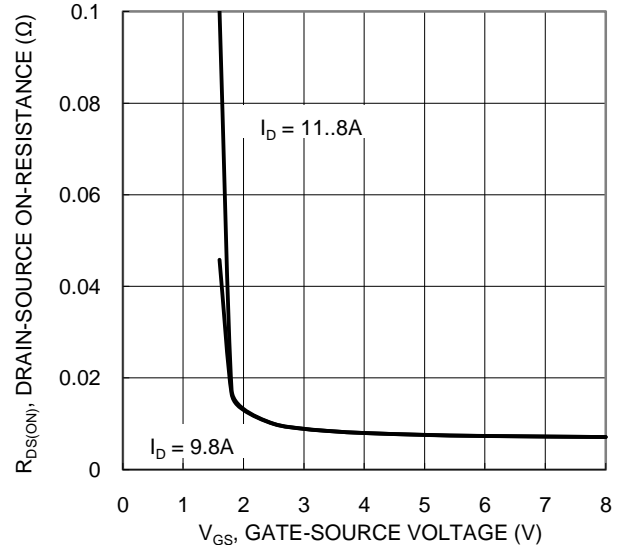


Figure 4. Typical Transfer Characteristic

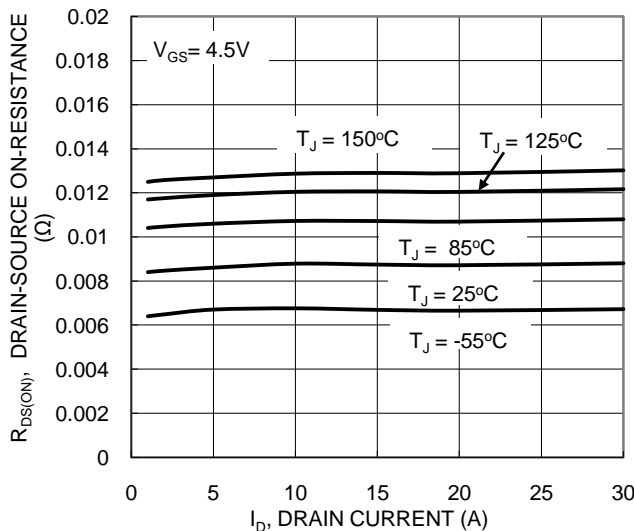


Figure 5. Typical On-Resistance vs Drain Current and Temperature

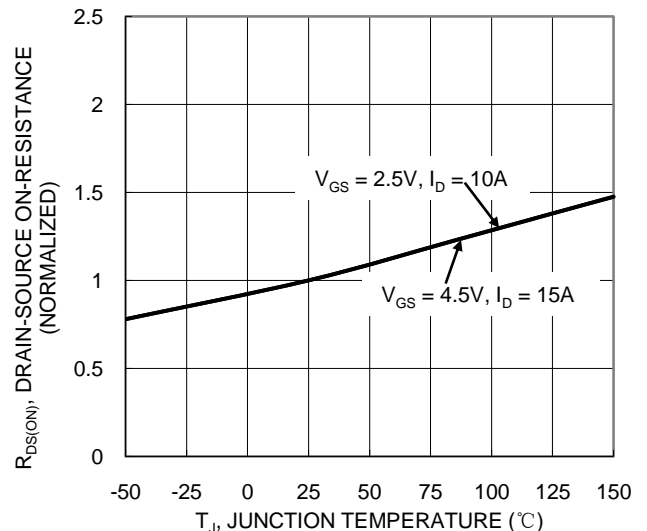


Figure 6. On-Resistance Variation with Junction Temperature

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

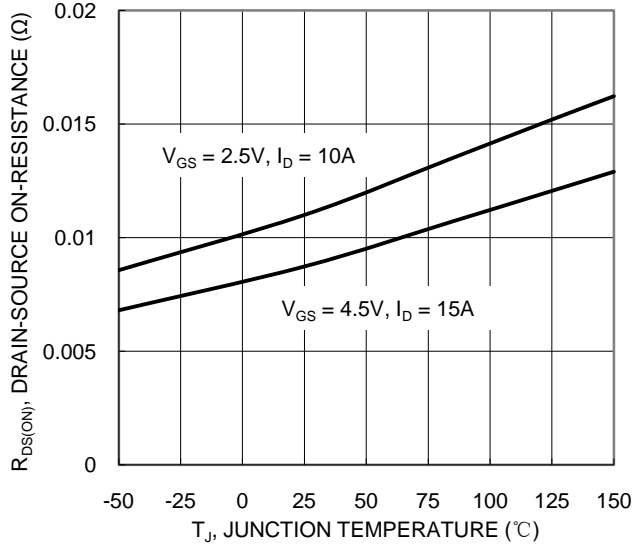


Figure 7. On-Resistance Variation with Junction Temperature

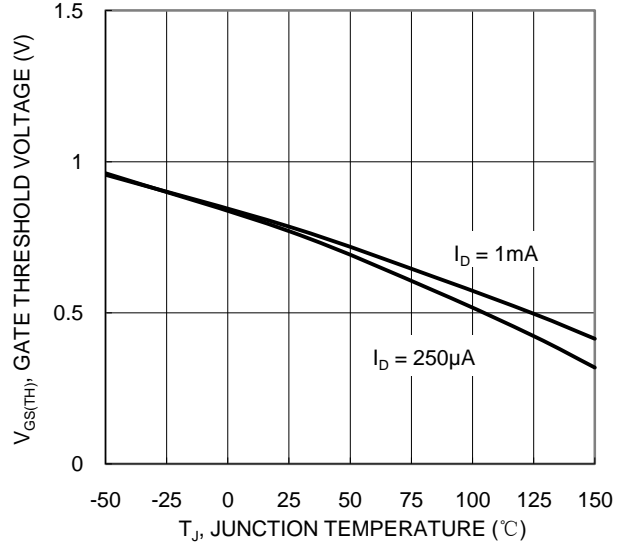


Figure 8. Gate Threshold Variation vs Junction Temperature

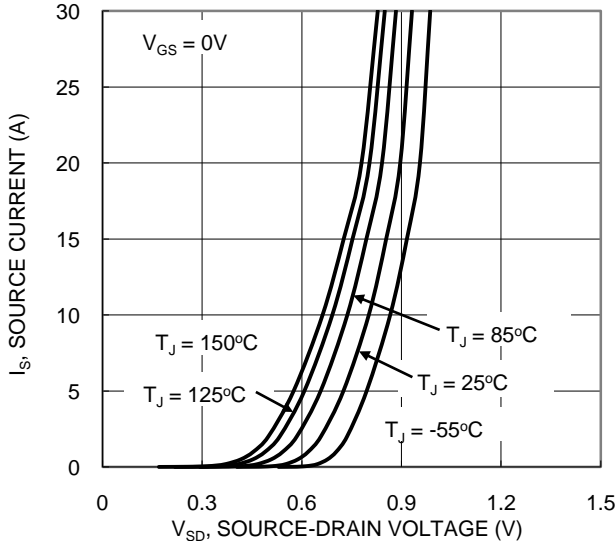


Figure 9. Diode Forward Voltage vs. Current

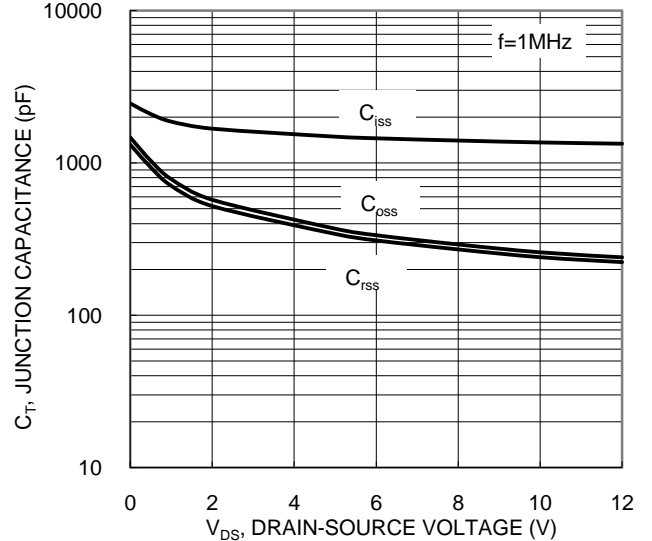


Figure 10. Typical Junction Capacitance

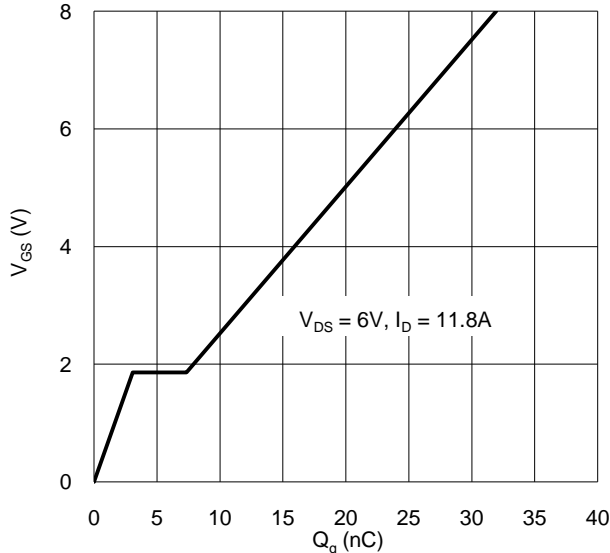


Figure 11. Gate Charge

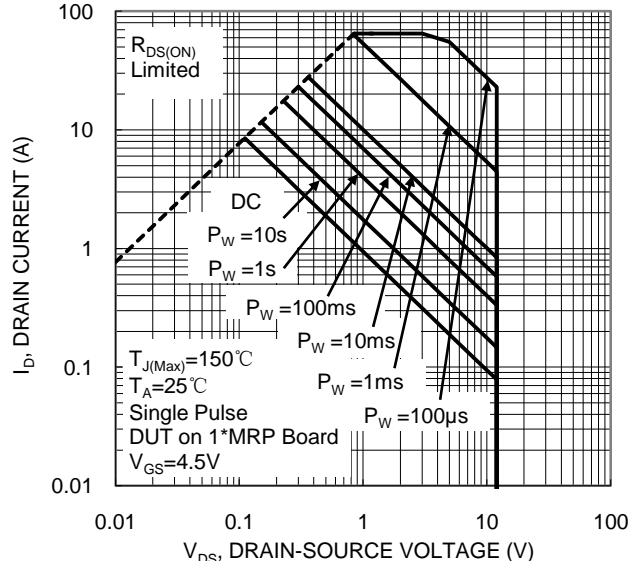


Figure 12. SOA, Safe Operation Area

**Typical Characteristics - P-CHANNEL**

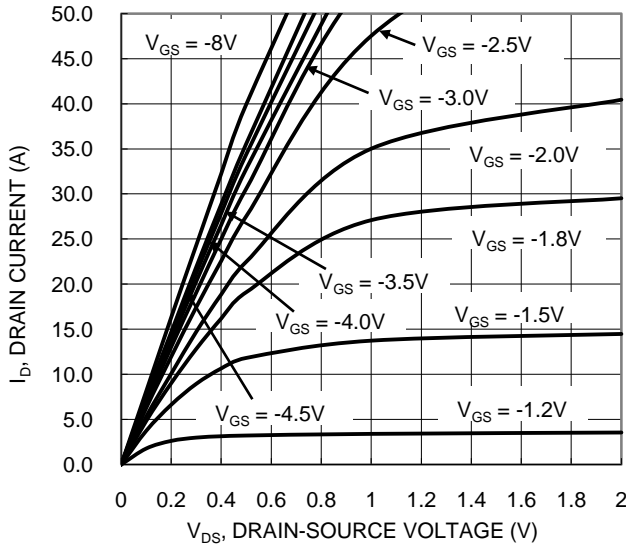


Figure 13. Typical Output Characteristic

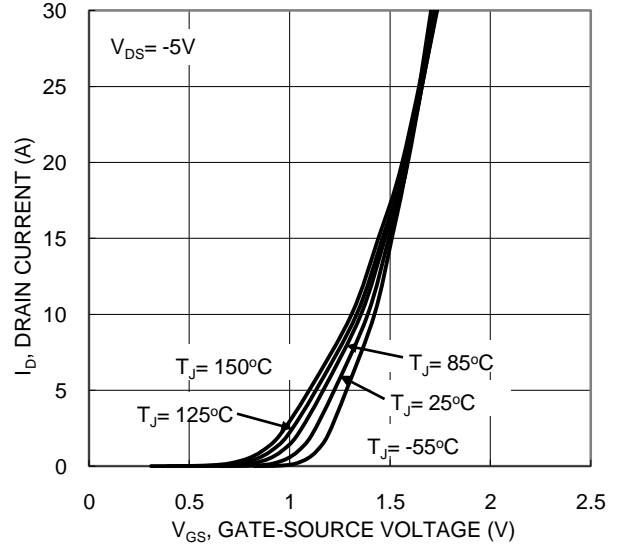


Figure 14. Typical Transfer Characteristic

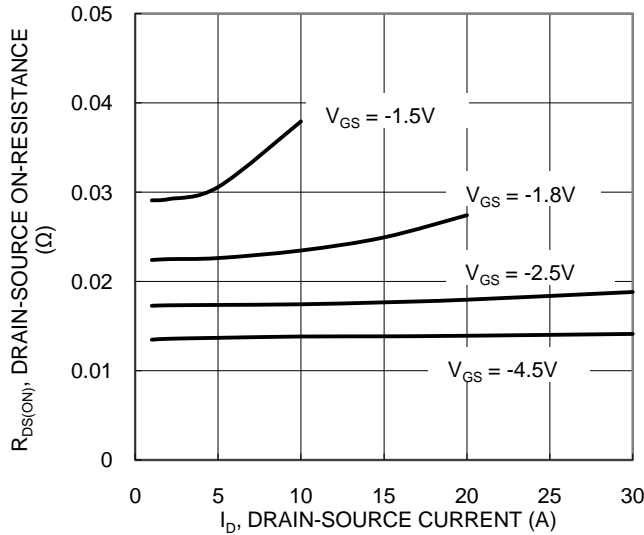


Figure 15. Typical On-Resistance vs Drain Current and Gate Voltage

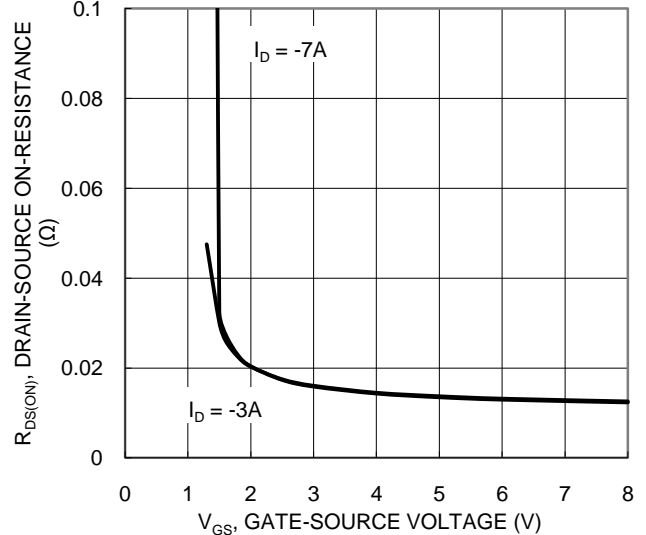


Figure 16. Typical Transfer Characteristic

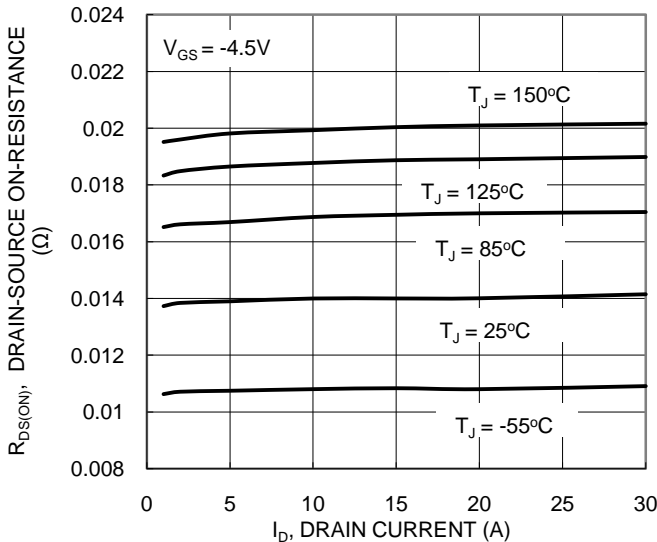


Figure 17. Typical On-Resistance vs Drain Current and Temperature

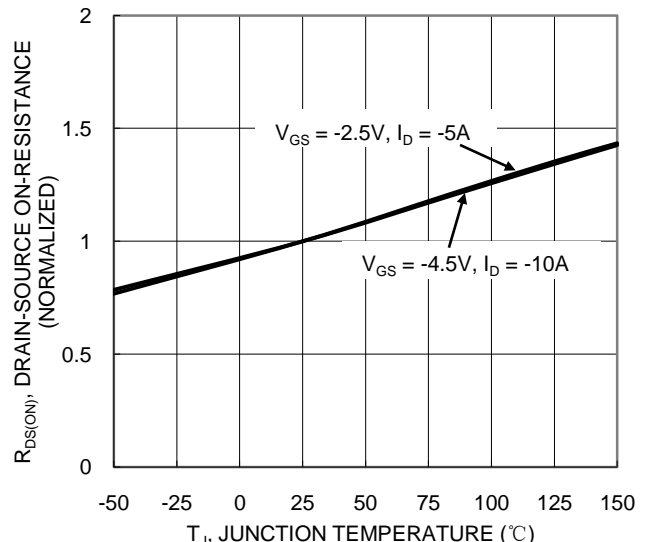


Figure 18. On-Resistance Variation with junction Temperature

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

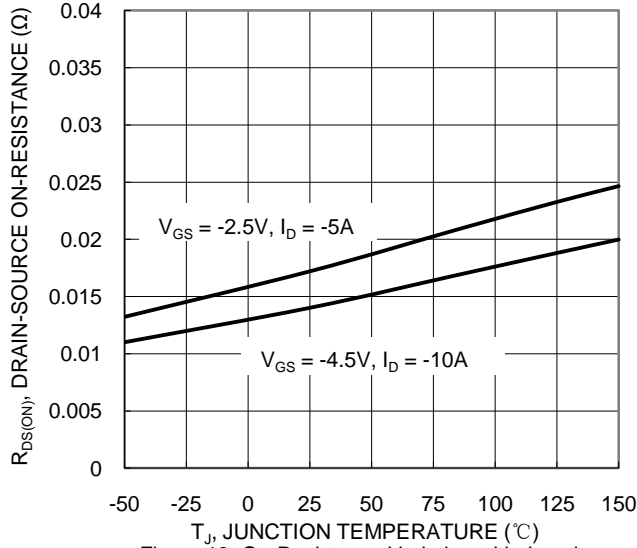


Figure 19. On-Resistance Variation with Junction Temperature

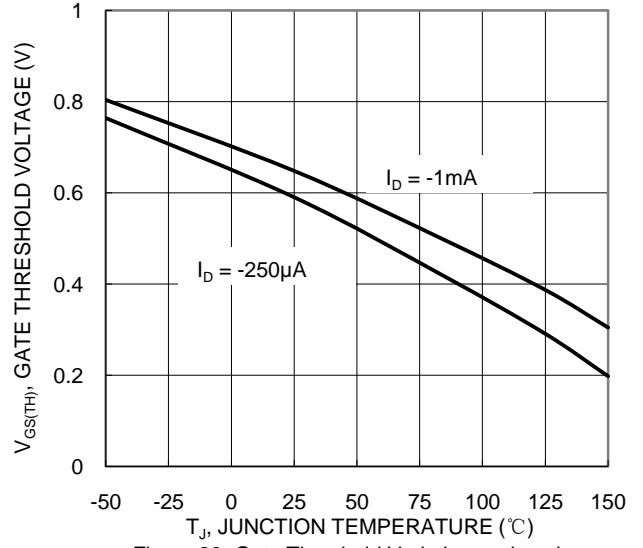


Figure 20. Gate Threshold Variation vs Junction Temperature

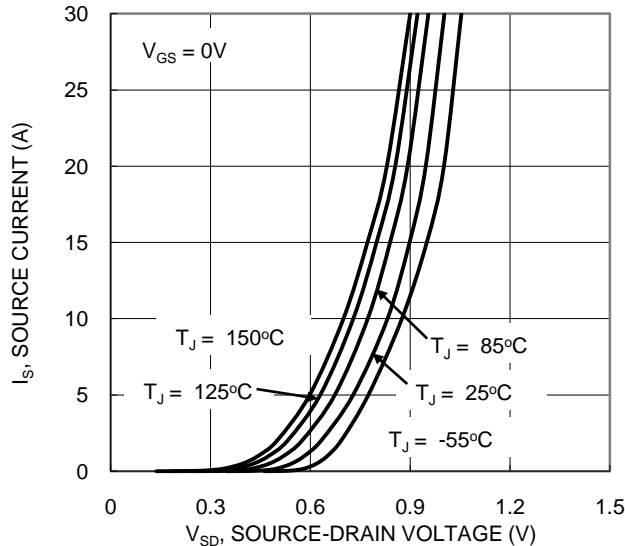


Figure 21. Diode Forward Voltage vs. Current

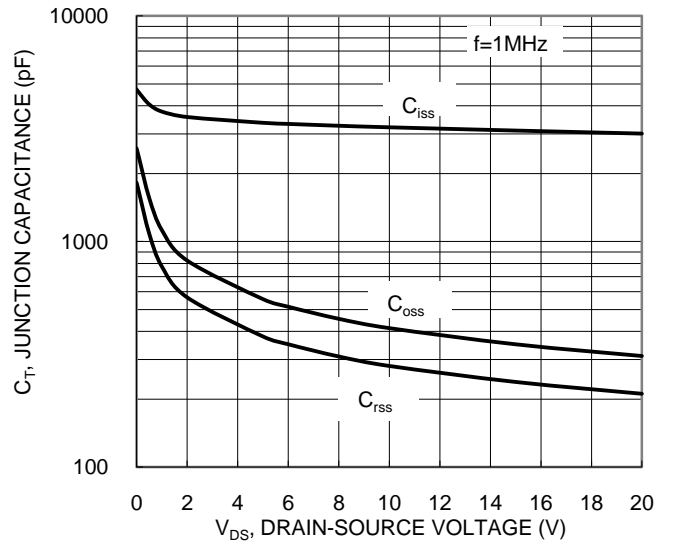


Figure 22. Typical Junction Capacitance

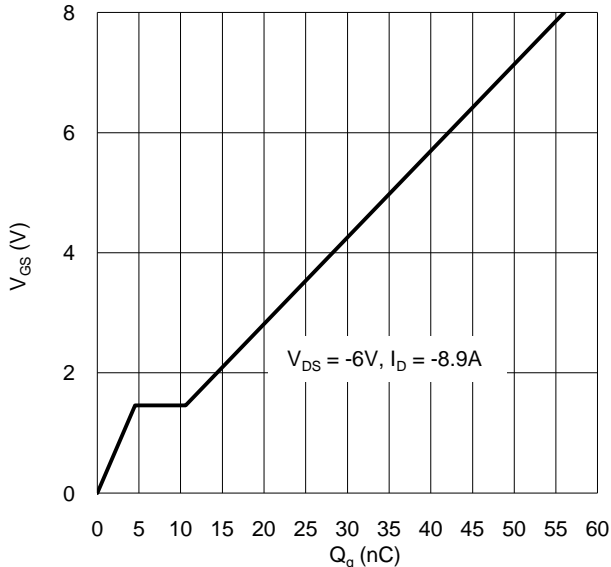


Figure 23. Gate Charge

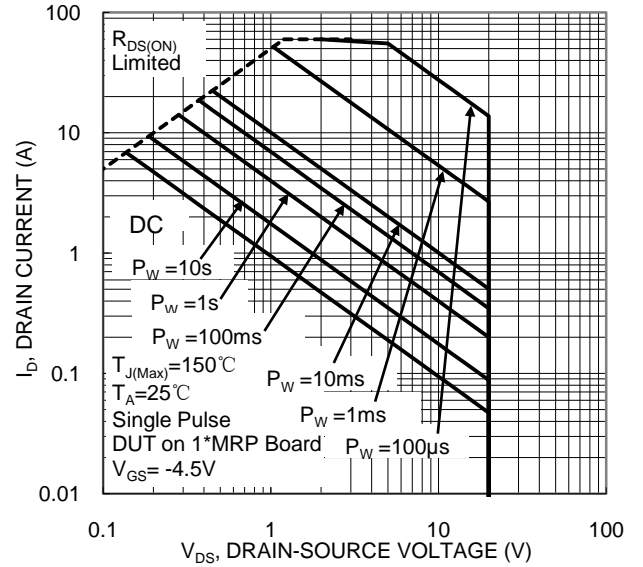


Figure 24. SOA, Safe Operation Area

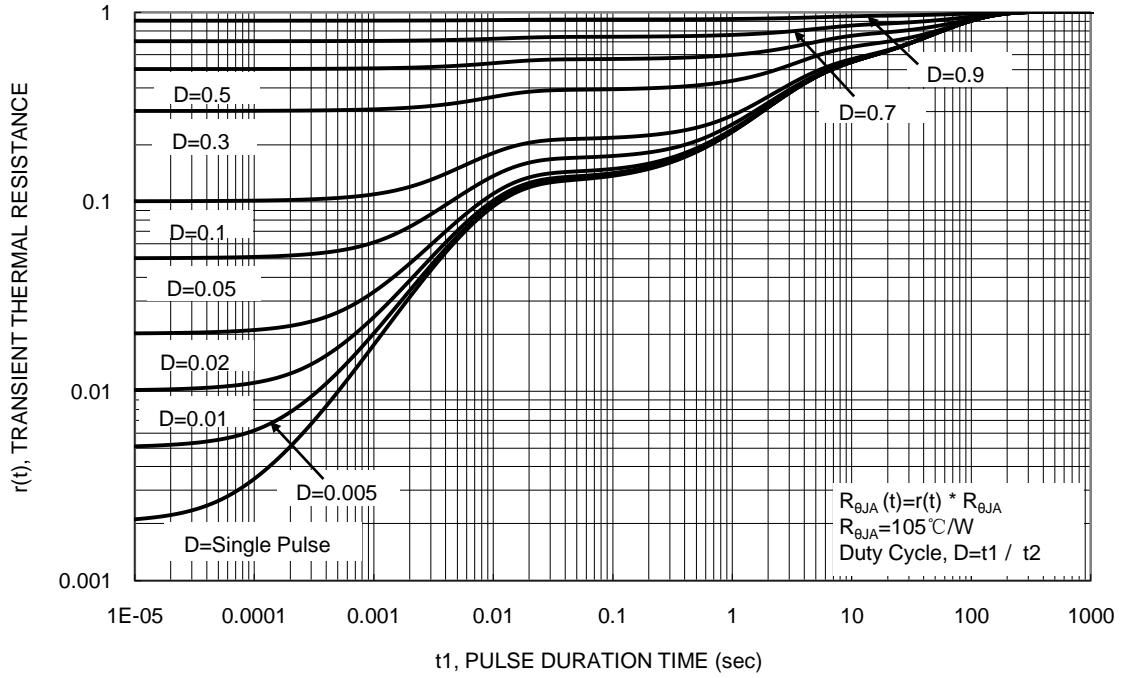


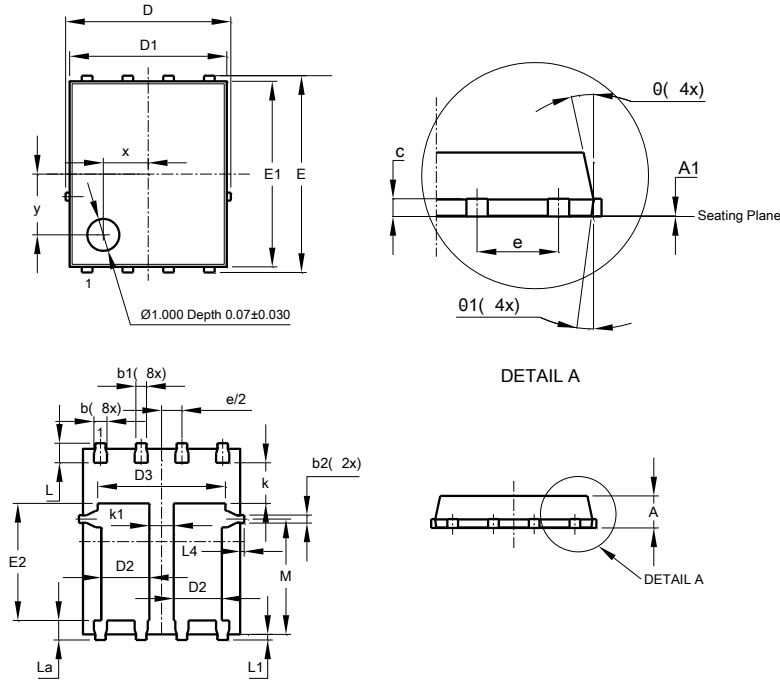
Figure 25. Transient Thermal Resistance



**Package Outline Dimensions**

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

**PowerDI5060-8 (Type C)**

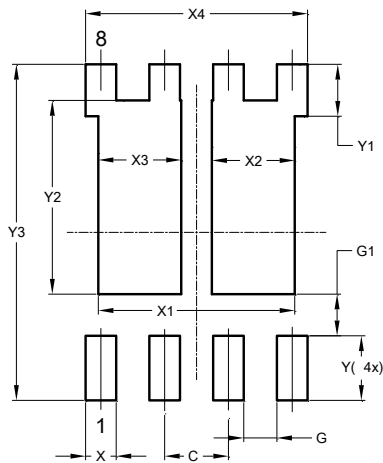


PowerDI5060-8 (Type C)			
Dim	Min	Max	Typ
A	0.90	1.10	1.00
A1	0	0.05	0.02
b	0.33	0.51	0.41
b1	0.300	0.366	0.333
b2	0.20	0.35	0.25
c	0.23	0.33	0.277
D	5.15 BSC		
D1	4.85	4.95	4.90
D2	1.40	1.60	1.50
D3	-	-	3.98
E	6.15 BSC		
E1	5.75	5.85	5.80
E2	3.56	3.76	3.66
e	1.27BSC		
k	-	-	1.27
k1	0.56	-	-
L	0.51	0.71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