



#### 60V P-CHANNEL ENHANCEMENT MODE MOSFET PowerDI5060-8

## **Product Summary**

BV <sub>DSS</sub>	R <sub>DS(ON)</sub>	I <sub>D</sub> T <sub>C</sub> = +25°C	
-60V	$50m\Omega$ @ $V_{GS} = -10V$	-26A	
	70m $Ω$ @ V <sub>GS</sub> = -4.5V	-22A	

## **Description and Applications**

This new generation 60V P-Channel Enhancement Mode MOSFET is designed to minimize  $R_{DS(ON)}$  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**

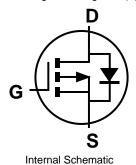
- Thermally Efficient Package-Cooler Running Applications
- High Conversion Efficiency
- Low R<sub>DS(ON)</sub> Minimizes On State Losses
- Low Input Capacitance
- Fast Switching Speed
- <1.1mm Package Profile Ideal for Thin Applications</li>
- Lead-Free Finish; RoHS Compliant (Notes 1 & 2)
- Halogen and Antimony Free. "Green" Device (Note 3)

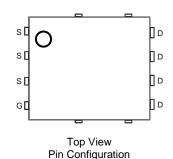
#### **Mechanical Data**

- 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
- Terminal Finish Matte Tin Annealed over Copper Leadframe;
   Solderable per MIL-STD-202, Method 208 <sup>(3)</sup>
- Weight: 0.097 grams (Approximate)



Top View Bottom View





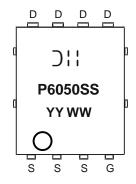
## **Ordering Information** (Note 4)

Part Number	Case	Packaging
DMP6050SPS-13	PowerDI5060-8	2500 / Tape & Reel

Notes:

- 1. EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant. All applicable RoHS exemptions applied.
- 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!! = Manufacturer's Marking
P6050SS = Product Type Marking Code
YYWW = Date Code Marking
YY = Last Two Digits of Year (ex: 18 = 2018)
WW = Week Code (01 to 53)



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

Characteristic			Symbol	Value	Unit
Drain-Source Voltage			V <sub>DSS</sub>	-60	V
Gate-Source Voltage			V <sub>GSS</sub>	±20	V
Continuous Drain Current (Note 6) V <sub>GS</sub> = -10V	Steady State	$T_A = +25^{\circ}C$ $T_A = +70^{\circ}C$	I <sub>D</sub>	-5.7 -4.5	А
Pulsed Drain Current (10µs Pulse, Duty Cycle = 1%)			I <sub>DM</sub>	-45	Α
Maximum Continuous Body Diode Forward Current (Note 6)			Is	-2.4	Α
Pulsed Body Diode Forward Current (10µs Pulse, Duty Cycle = 1%)			I <sub>SM</sub>	-45	Α
Avalanche Current (Note 8) L = 0.1mH			I <sub>AS</sub>	-25	Α
Repetitive Avalanche Energy (Note 8) L = 0.1mH		Eas	32	mJ	

## **Thermal Characteristics**

Characteristic	Symbol	Value	Unit
Power Dissipation (Note 5)	P <sub>D</sub>	1.3	W
Thermal Resistance, Junction to Ambient @ T <sub>A</sub> = +25°C (Note 5)	R <sub>θJA</sub>	95	°C/W
Power Dissipation (Note 6)	P <sub>D</sub>	2.4	W
Thermal Resistance, Junction to Ambient @ T <sub>A</sub> = +25°C (Note 6)	R <sub>θJA</sub>	52	°C/W
Thermal Resistance, Junction to Case @ T <sub>C</sub> = +25°C (Note 7)	R <sub>0JC</sub>	2.4	°C/W
Operating and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-55 to +150	°C

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

Characteristic	Symbol	Min	Тур	Max	Unit	Test Condition	
OFF CHARACTERISTICS (Note 9)							
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	-60	_	_	V	$V_{GS} = 0V, I_D = -250\mu A$	
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	_	_	-1	μA	$V_{DS} = -60V, V_{GS} = 0V$	
Gate-Source Leakage	I <sub>GSS</sub>	_	_	±100	nA	$V_{GS} = \pm 20V, V_{DS} = 0V$	
ON CHARACTERISTICS (Note 9)						•	
Gate Threshold Voltage	V <sub>GS(TH)</sub>	-1.0	_	-3.0	V	$V_{DS} = V_{GS}$ , $I_D = -250\mu A$	
Static Drain-Source On-Resistance	В	_	43	50	mΩ	$V_{GS} = -10V, I_D = -5A$	
Static Dialii-Source On-Resistance	R <sub>DS(ON)</sub>	_	53	70	11122	$V_{GS} = -4.5V, I_D = -4A$	
Diode Forward Voltage	V <sub>SD</sub>	_	-0.7	-1.2	V	V <sub>GS</sub> = 0V, I <sub>S</sub> = -1A	
DYNAMIC CHARACTERISTICS (Note 10)	•	•	•		•	•	
Input Capacitance	C <sub>iss</sub>	_	2163	_	pF	.,	
Output Capacitance	Coss	_	88	_	pF	$V_{DS} = -30V, V_{GS} = 0V,$ -f = 1.0MHz	
Reverse Transfer Capacitance	Crss	_	58	_	pF	71 - 1.01/11/12	
Gate Resistance	Rg	_	13	_	Ω	$V_{DS} = 0V$ , $V_{GS} = 0V$ , $f = 1MHz$	
Total Gate Charge (V <sub>GS</sub> = -10V)	Qg	_	30	_	nC		
Total Gate Charge (V <sub>GS</sub> = -4.5V)	Qg	_	14	_	nC	), 20V I 5A	
Gate-Source Charge	Qgs	_	5	_	nC	$V_{DS} = -30V, I_{D} = -5A$	
Gate-Drain Charge	Q <sub>gd</sub>	_	4.6	<u> </u>	nC	1	
Turn-On Delay Time	t <sub>D(ON)</sub>	_	4.7	_	ns		
Turn-On Rise Time	t <sub>R</sub>	_	2.7	_	ns	$V_{GS} = -10V, V_{DS} = -30V,$ $R_G = 3\Omega, I_D = -5A$	
Turn-Off Delay Time	t <sub>D(OFF)</sub>	_	73	_	ns		
Turn-Off Fall Time	t <sub>F</sub>	_	25	_	ns		
Body Diode Reverse Recovery Time	t <sub>RR</sub>	_	18	_	ns	$I_F = -5A$ , di/dt = 100A/ $\mu$ s	
Body Diode Reverse Recovery Charge	Q <sub>RR</sub>	_	12	_	nC	$I_F = -5A$ , $di/dt = 100A/\mu s$	

5. Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout. Notes:

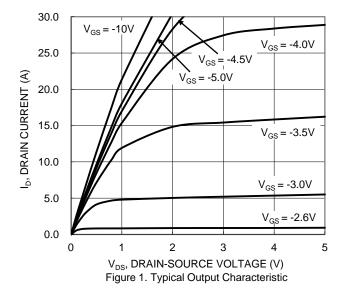
<sup>6.</sup> Device mounted on FR-4 substrate PC board, 2oz copper, with 1inch square copper plate.

<sup>7.</sup> Thermal resistance from junction to soldering point (on the exposed drain pad).

<sup>8.</sup>  $I_{AS}$  and  $E_{AS}$  ratings are based on low frequency and duty cycles to keep  $T_J$  = +25°C. 9. Short duration pulse test used to minimize self-heating effect.

<sup>10.</sup> Guaranteed by design. Not subject to product testing.





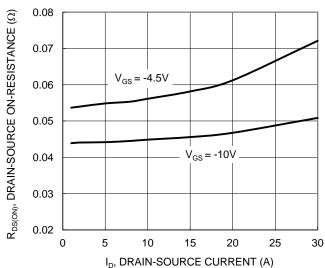


Figure 3. Typical On-Resistance vs. Drain Current and Gate Voltage

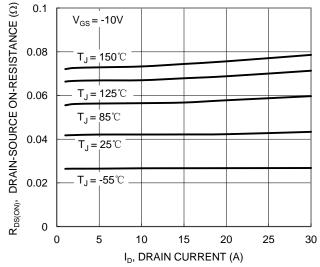
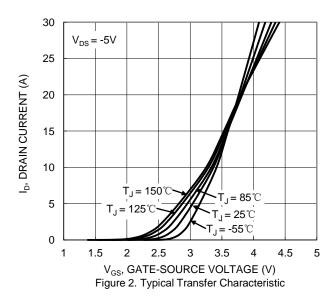


Figure 5. Typical On-Resistance vs. Drain Current and Junction Temperature



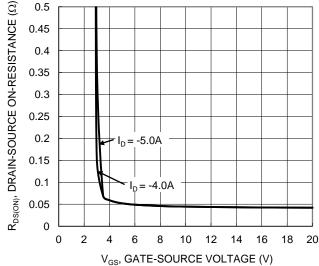


Figure 4. Typical Transfer Characteristic

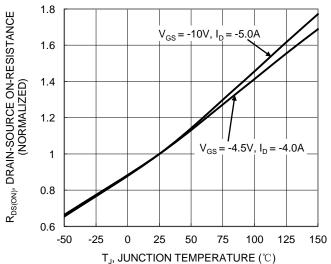


Figure 6. On-Resistance Variation with Junction
Temperature



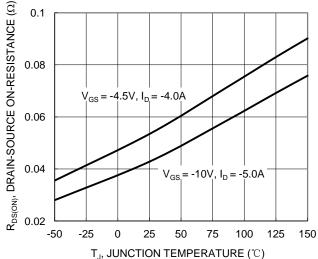


Figure 7. On-Resistance Variation with Junction Temperature

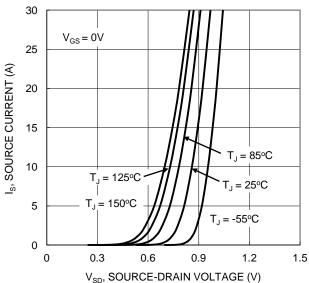
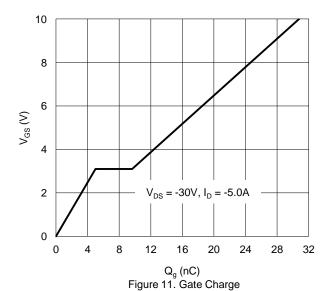
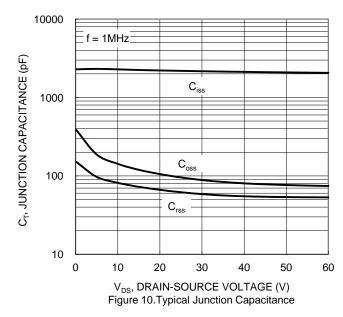


Figure 9. Diode Forward Voltage vs. Current



2.4 V<sub>GS(TH)</sub>, GATE THRESHOLD VOLTAGE (V) 2.2  $I_D = -1mA$ 2 1.8  $I_{D} = -250 \mu A$ 1.6 1.4 1.2 0 -25 25 50 75 100 -50 125 150  $T_J$ , JUNCTION TEMPERATURE (°C)

Figure 8. Gate Threshold Variation vs. Junction Temperature



100 R<sub>DS(ON)</sub> Limited DRAIN CURRENT (A) 10  $P_W = 10\mu \hat{s}$ 1 10ms مُ\_  $T_{J(Max)} = 150^{\circ}C \quad T_C = 25^{\circ}C$  $P_{W} = 100 ms$ Single Pulse **DUT** on Infinite Heatsink  $V_{GS} = -10V$ 0.1 0.1 10 100 V<sub>DS</sub>, DRAIN-SOURCE VOLTAGE (V)

Figure 12. SOA, Safe Operation Area



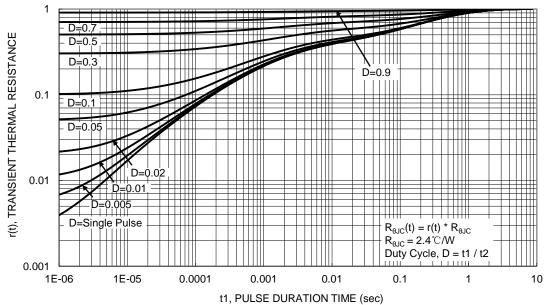


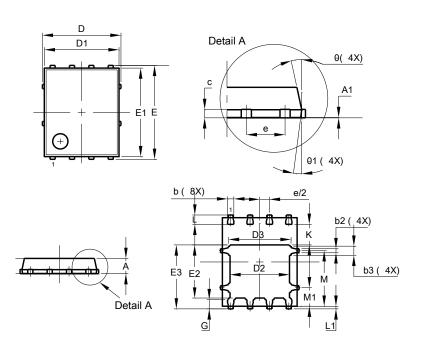
Figure 13. Transient Thermal Resistance



# **Package Outline Dimensions**

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

#### PowerDI5060-8

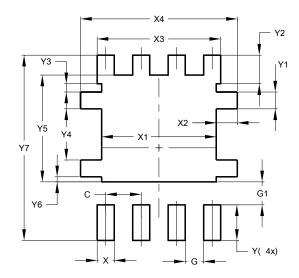


PowerDI5060-8					
Dim	Min	Max	Тур		
Α	0.90	1.10	1.00		
A1	0.00	0.05	1		
b	0.33	0.51	0.41		
b2	0.200	0.350	0.273		
b3	0.40	0.80	0.60		
C D	0.230	0.330	0.277		
D		5.15 BSC	;		
D1	4.70	5.10	4.90		
D2	3.70	4.10	3.90		
D3	3.90	4.30	4.10		
Е	(	6.15 BSC	;		
E1	5.60	6.00	5.80		
E2	3.28	3.68	3.48		
E3	3.99	4.39	4.19		
е	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°		
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



Dimensions	Value (in mm)			
С	1.270			
G	0.660			
G1	0.820			
Χ	0.610			
X1	4.100			
X2	0.755			
Х3	4.420			
X4	5.610			
Υ	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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