

# MOSFET – P-Channel, Logic Level, POWERTRENCH®

**-40 V, -65 A, 8.0 mΩ**

## FDWS9509L-F085

### Features

- Typ  $R_{DS(on)} = 6.3 \text{ mΩ}$  at  $V_{GS} = -10 \text{ V}$ ;  $I_D = -65 \text{ A}$
- Typ  $Q_{g(\text{tot})} = 48 \text{ nC}$  at  $V_{GS} = -10 \text{ V}$ ;  $I_D = -65 \text{ A}$
- UIS Capability
- Wettable Flanks for Automatic Optical Inspection (AOI)
- AEC-Q101 Qualified and PPAP Capable
- This Device is Pb-Free, Halogen Free/BFR Free and is RoHS Compliant

### Applications

- Automotive Engine Control
- PowerTrain Management
- Solenoid and Motor Drivers
- Electronic Steering
- Integrated Starter/Alternator
- Distributed Power Architectures and VRM
- Primary Switch for 12 V Systems

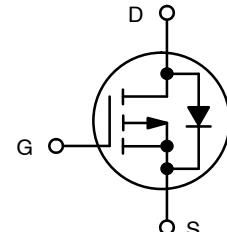
### MOSFET MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DSS}$	-40	V
Gate-to-Source Voltage	$V_{GS}$	$\pm 16$	V
Continuous Drain Current ( $V_{GS} = 10 \text{ V}$ ) (Note 1)	$I_D$	-65	A
Pulsed Drain Current		See Figure 4	
Single Pulse Avalanche Energy (Note 2)	$E_{AS}$	84	mJ
Power Dissipation	$P_D$	107	W
Derate above $25^\circ\text{C}$		0.71	W/ $^\circ\text{C}$
Operating and Storage Temperature	$T_J, T_{STG}$	-55 to +175	$^\circ\text{C}$
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$	1.4	$^\circ\text{C}/\text{W}$
Maximum Thermal Resistance (Junction-to-Ambient) (Note 3)	$R_{\theta JA}$	50	$^\circ\text{C}/\text{W}$

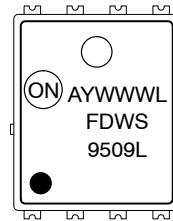
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Current is limited by wirebond configuration.
2. Starting  $T_J = 25^\circ\text{C}$ ,  $L = 50 \mu\text{H}$ ,  $I_{AS} = 56 \text{ A}$ ,  $V_{DD} = -40 \text{ V}$  during inductor charging and  $V_{DD} = 0 \text{ V}$  during time in avalanche.
3.  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta JA}$  is determined by the user's board design. The maximum rating presented here is based on mounting on a 1 in<sup>2</sup> pad of 2 oz copper.

$V_{DSS}$	$R_{DS(\text{ON}) \text{ MAX}}$	$I_D \text{ MAX}$
-40 V	8.0 mΩ @ -10 V	-65 A



### MARKING DIAGRAM



A = Assembly Location  
 Y = Year  
 WW = Work Week  
 WL = Assembly Lot  
 FDWS9509L = Specific Device Code

### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
FDWS9509L-F085	DFNW8 (Power 56) (Pb-Free)	3000 / Tape & Reel

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

# FDWS9509L-F085

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Conditions		Min	Typ	Max	Unit					
<b>OFF CHARACTERISTICS</b>												
$B_{VDSS}$	Drain-to-Source Breakdown Voltage	$I_D = -250 \mu\text{A}$ , $V_{GS} = 0 \text{ V}$		-40	-	-	V					
$I_{DSS}$	Drain-to-Source Leakage Current	$V_{DS} = -40 \text{ V}$ , $V_{GS} = 0 \text{ V}$	$T_J = 25^\circ\text{C}$	-	-	1	$\mu\text{A}$					
$I_{GSS}$	Gate-to-Source Leakage Current	$V_{GS} = \pm 16 \text{ V}$		-	-	$\pm 100$	nA					
<b>ON CHARACTERISTICS</b>												
$V_{GS(\text{th})}$	Gate-to-Source Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = -250 \mu\text{A}$		-1	-1.7	-3	V					
$R_{DS(\text{on})}$	Drain-to-Source On-Resistance	$I_D = -65 \text{ A}$ , $V_{GS} = -4.5 \text{ V}$		-	10.7	15.3	$\text{m}\Omega$					
		$I_D = -65 \text{ A}$ $V_{GS} = -10 \text{ V}$	$T_J = 25^\circ\text{C}$	-	6.3	8.0	$\text{m}\Omega$					
		$T_J = 175^\circ\text{C}$ (Note 4)		-	10.6	13.0						
<b>DYNAMIC CHARACTERISTICS</b>												
$C_{iss}$	Input Capacitance	$V_{DS} = -20 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $f = 1 \text{ MHz}$		-	3360	-	pF					
$C_{oss}$	Output Capacitance			-	1230	-						
$C_{rss}$	Reverse Transfer Capacitance			-	38	-						
$R_g$	Gate Resistance	$V_{GS} = 0.5 \text{ V}$ , $f = 1 \text{ MHz}$		-	21	-	$\Omega$					
$Q_{g(\text{tot})}$	Total Gate Charge	$V_{GS} = 0 \text{ to } -10 \text{ V}$	$V_{DD} = -20 \text{ V}$ , $I_D = -65 \text{ A}$	-	48	67	nC					
$Q_{g(\text{th})}$	Threshold Gate Charge	$V_{GS} = 0 \text{ to } -2 \text{ V}$		-	7	-						
$Q_{gs}$	Gate-to-Source Gate Charge			-	12	-						
$Q_{gd}$	Gate-to-Drain "Miller" Charge			-	6	-						
<b>SWITCHING CHARACTERISTICS</b>												
$t_{on}$	Turn-On Time	$V_{DD} = -20 \text{ V}$ , $I_D = -65 \text{ A}$ , $V_{GS} = -10 \text{ V}$ , $R_{\text{GEN}} = 6 \Omega$		-	-	22	ns					
$t_{d(on)}$	Turn-On Delay			-	10	-						
$t_r$	Rise Time			-	5	-						
$t_{d(off)}$	Turn-Off Delay			-	198	-						
$t_f$	Fall Time			-	71	-						
$t_{off}$	Turn-Off Time			-	-	405						
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>												
$V_{SD}$	Source-to-Drain Diode Voltage	$I_{SD} = -65 \text{ A}$ , $V_{GS} = 0 \text{ V}$		-	1.0	-1.25	V					
		$I_{SD} = -32.5 \text{ A}$ , $V_{GS} = 0 \text{ V}$		-	0.9	-1.2						
$t_{rr}$	Reverse Recovery Time	$I_F = -65 \text{ A}$ , $dI_{SD}/dt = 100 \text{ A}/\mu\text{s}$		-	57	80	ns					
				-	45	67						
<small>Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.</small>												
<small>4. The maximum value is specified by design at <math>T_J = 175^\circ\text{C}</math>. Product is not tested to this condition in production</small>												

## TYPICAL CHARACTERISTICS

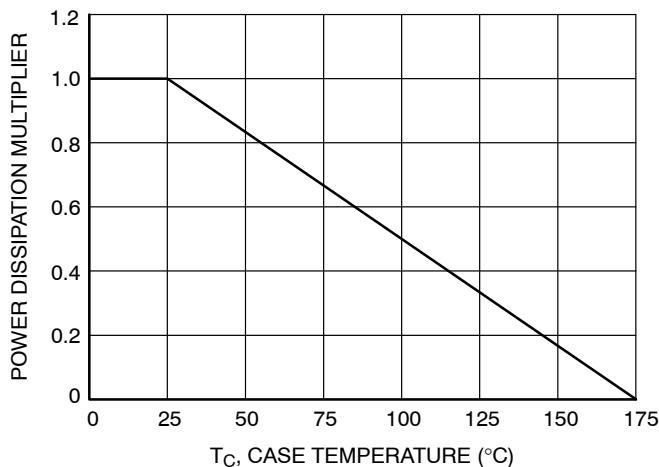


Figure 1. Normalized Power Dissipation vs.  
Case Temperature

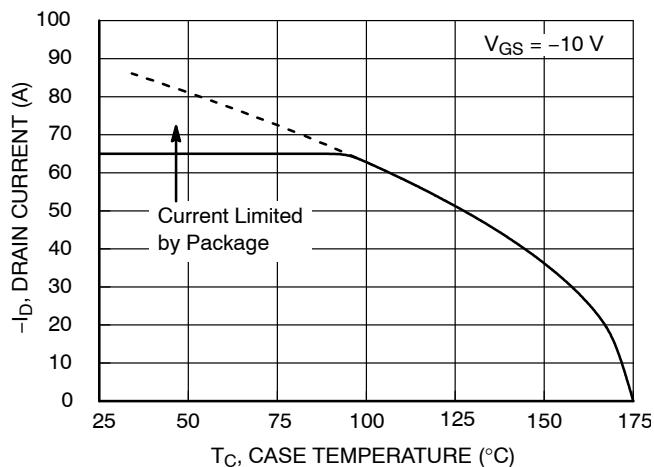


Figure 2. Maximum Continuous Drain Current vs.  
Case Temperature

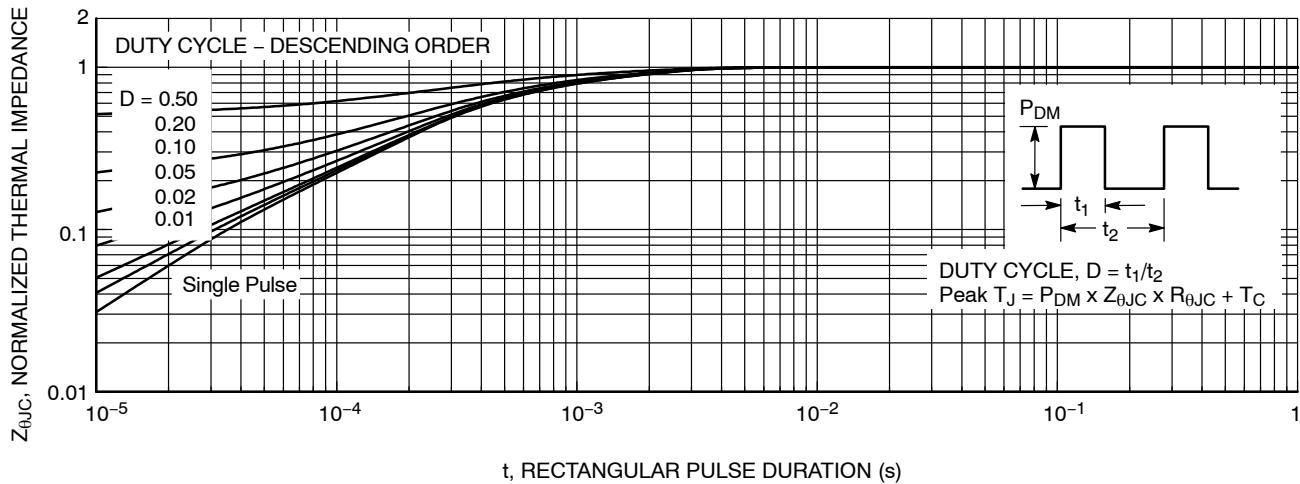


Figure 3. Normalized Maximum Transient Thermal Impedance

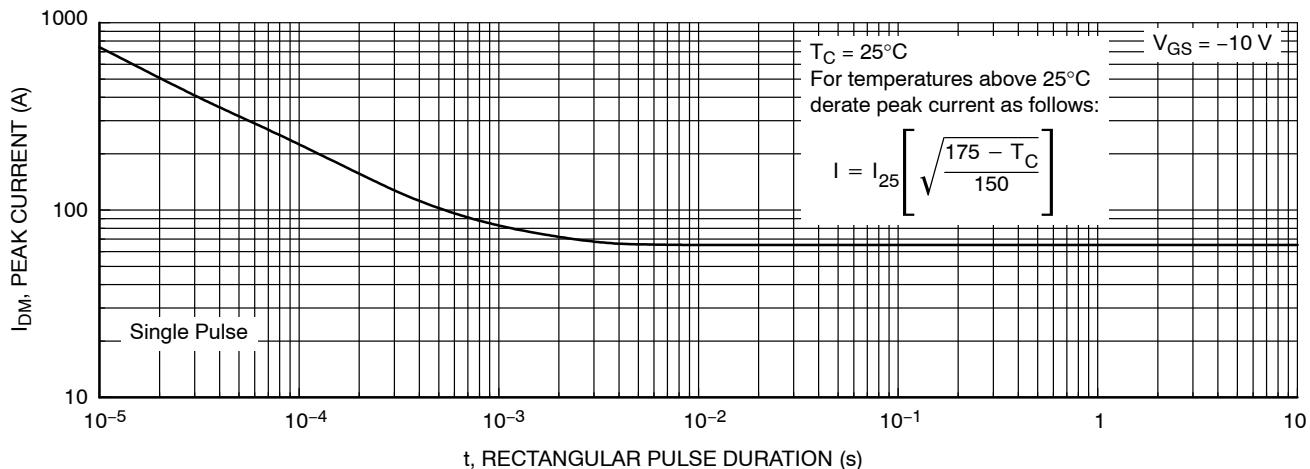


Figure 4. Peak Current Capability

## TYPICAL CHARACTERISTICS (continued)

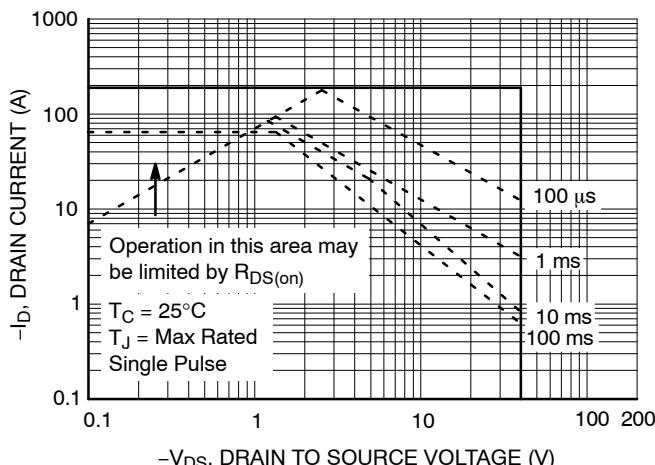


Figure 5. Forward Bias Safe Operating Area

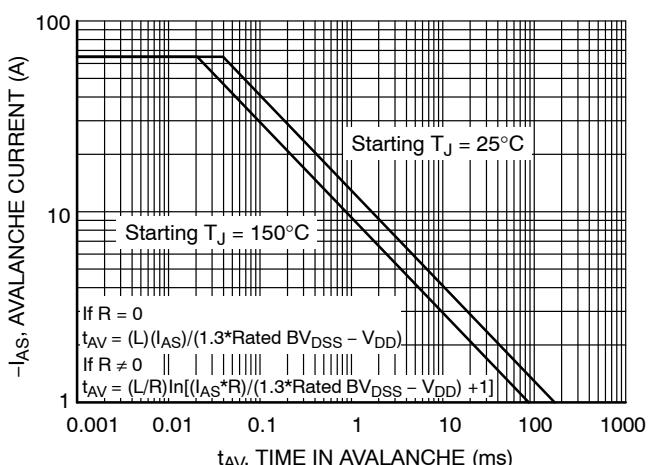


Figure 6. Unclamped Inductive Switching Capability

(Note: Refer to **onsemi** Applications Notes [AN7514](#) and [AN7515](#))

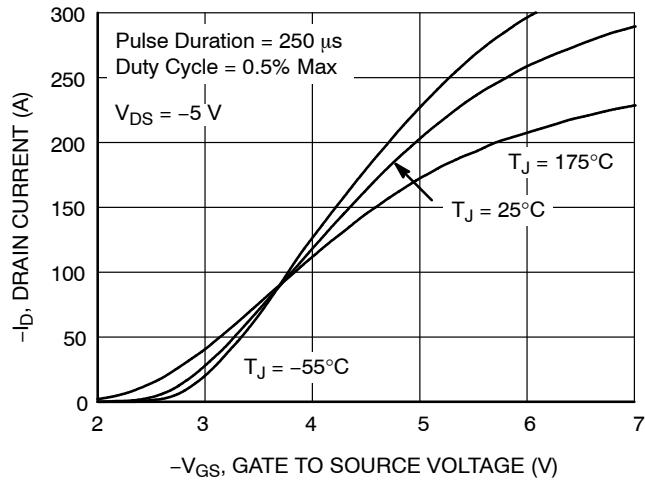


Figure 7. Transfer Characteristics

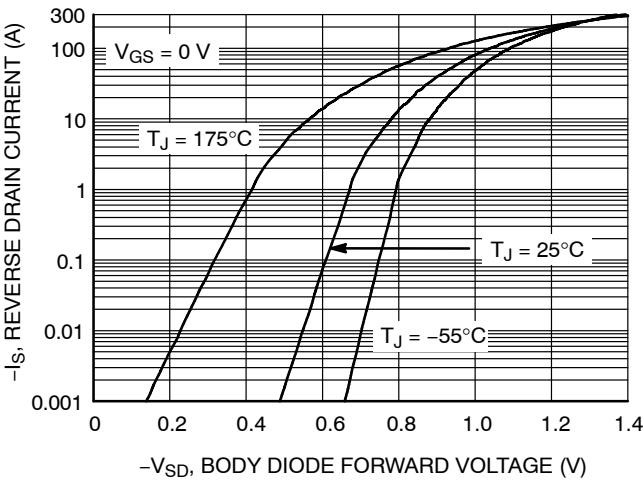


Figure 8. Forward Diode Characteristics

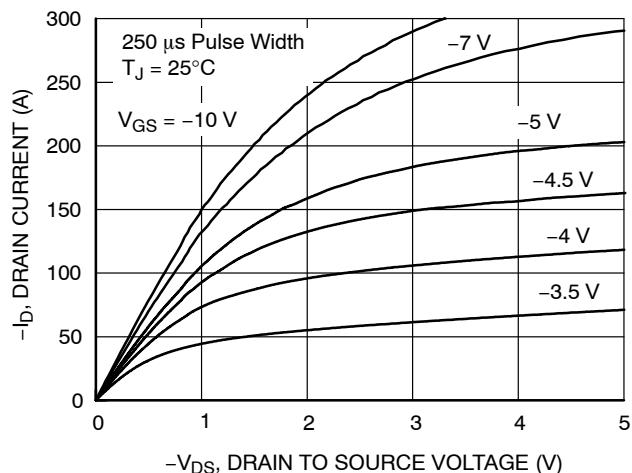


Figure 9. Saturation Characteristics

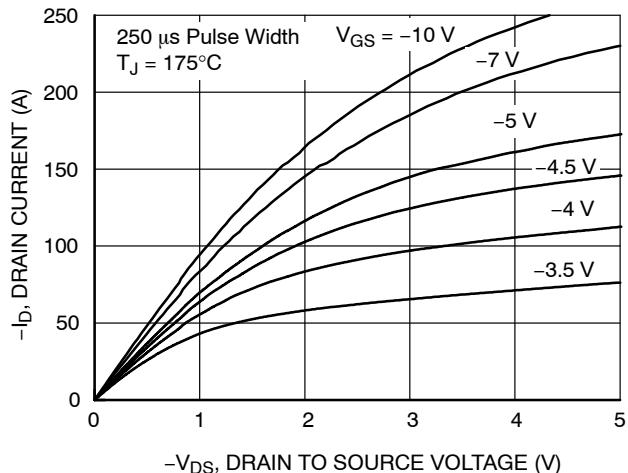


Figure 10. Saturation Characteristics

## TYPICAL CHARACTERISTICS (continued)

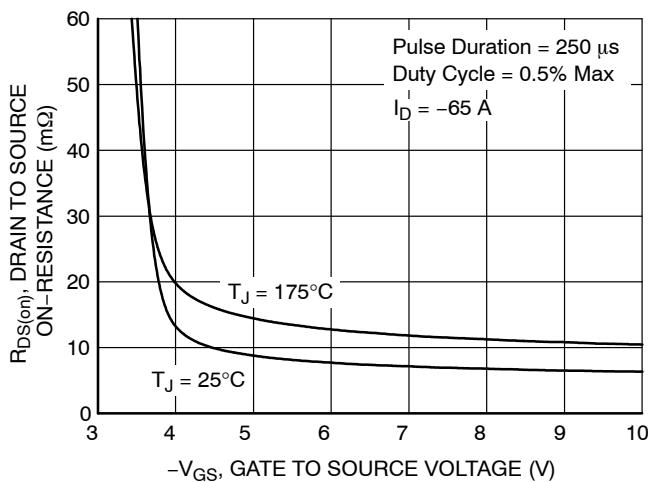
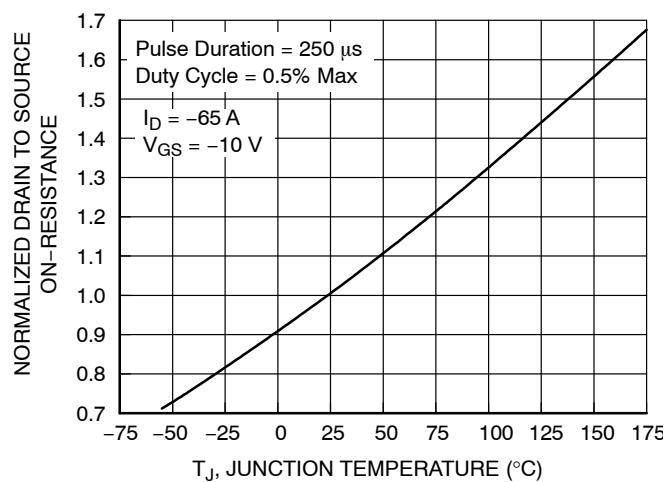
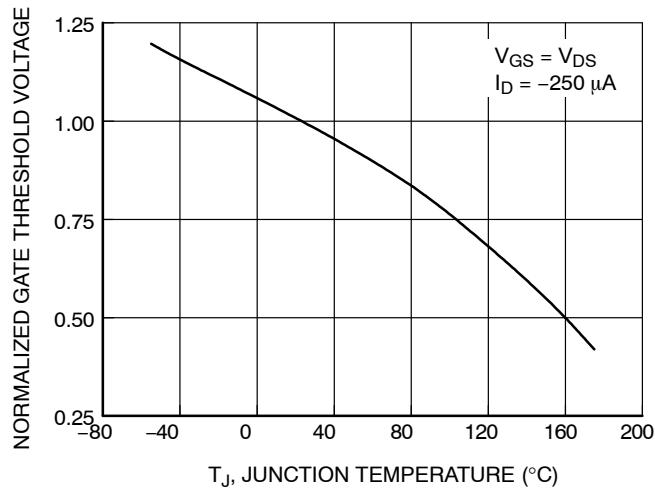
Figure 11.  $R_{DS(on)}$  vs. Gate VoltageFigure 12. Normalized  $R_{DS(on)}$  vs. Junction Temperature

Figure 13. Normalized Gate Threshold Voltage vs. Temperature

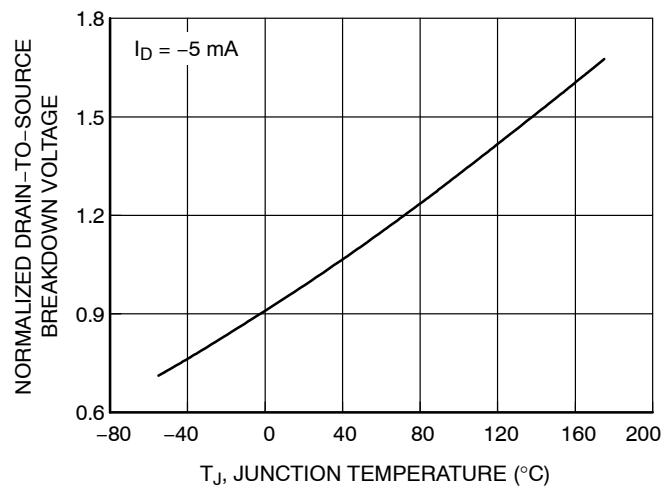


Figure 14. Normalized Drain to Source Breakdown Voltage vs. Junction Temperature

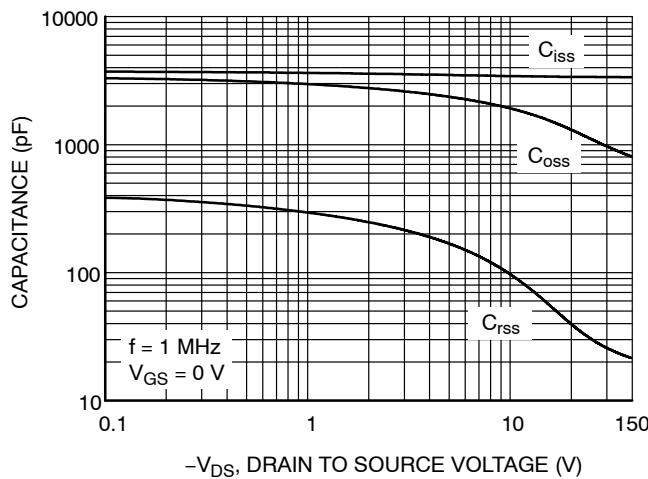


Figure 15. Capacitance vs. Drain to Source Voltage

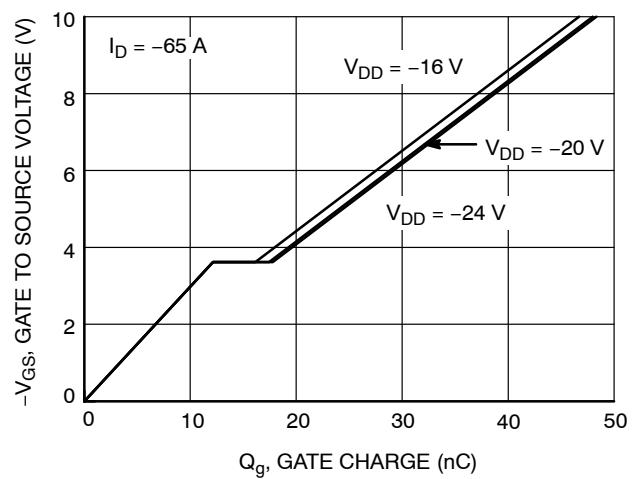


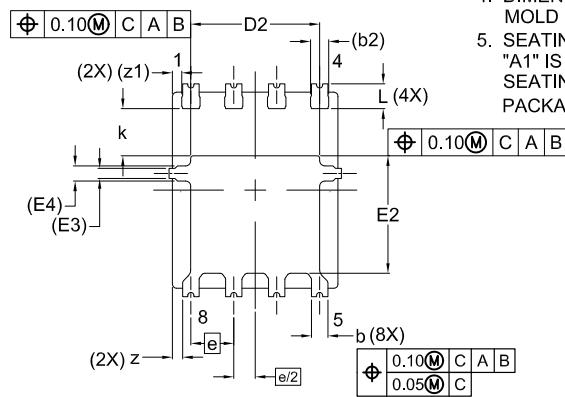
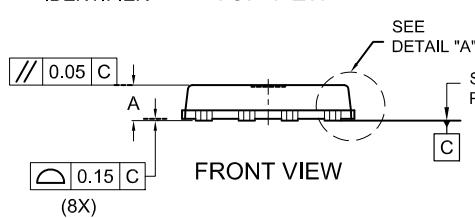
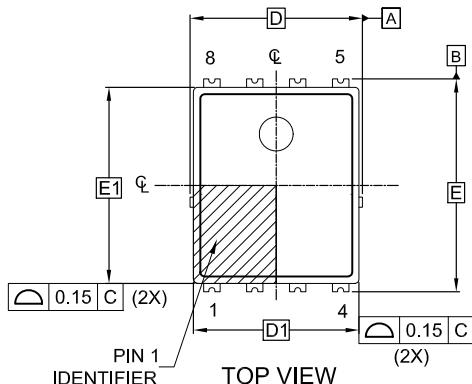
Figure 16. Gate Charge vs. Gate to Source Voltage

## PACKAGE DIMENSIONS

**DFNW8 5.2x6.3, 1.27P**

CASE 507AU

## ISSUE A

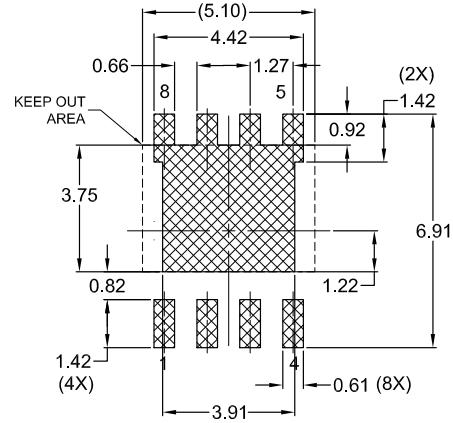


## BOTTOM VIEW

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. COPLANARITY APPLIES TO THE EXPOSED PADS AS WELL AS THE TERMINALS.
4. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.
5. SEATING PLANE IS DEFINED BY THE TERMINALS. "A1" IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.

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## LAND PATTERN RECOMMENDATION

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.90	1.00	1.10
A1	-	-	0.05
A2	0.65	0.75	0.85
A3	0.30 REF		
b	0.47	0.52	0.57
b1	0.13	0.18	0.23
b2	(0.54)		
D	5.00	5.10	5.20
D1	4.80	4.90	5.00
D2	3.72	3.82	3.92
E	6.20	6.30	6.40
E1	5.70	5.80	5.90
E2	3.38	3.48	3.58
E3	0.30 REF		
E4	0.45 REF		
e	1.27 BSC		
e/2	0.635BSC		
k	1.30	1.40	1.50
L	0.64	0.74	0.84
z	0.24	0.29	0.34
z1	(0.28)		
Θ	0°	---	12°

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