

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

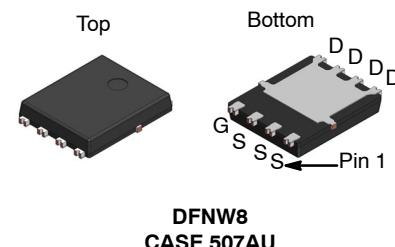
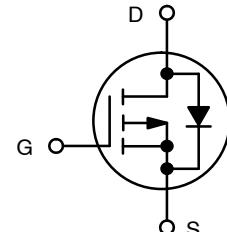
MOSFET MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter		Symbol	Value	Unit
Drain-to-Source Voltage		V_{DSS}	-40	V
Gate-to-Source Voltage		V_{GS}	± 16	V
Continuous Drain Current ($V_{GS} = 10 \text{ V}$) (Note 1)	$T_J = 25^\circ\text{C}$	I_D	-65	A
Pulsed Drain Current	$T_J = 25^\circ\text{C}$		See Figure 4	
Single Pulse Avalanche Energy (Note 2)		E_{AS}	84	mJ
Power Dissipation		P_D	107	W
Derate above 25°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	$^\circ\text{C}/\text{W}$

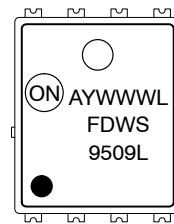
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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 in² 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 [†]
FDWS9509L-F085	DFNW8 (Power 56) (Pb-Free)	3000 / Tape & Reel

[†]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	
OFF CHARACTERISTICS								
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	μA	
I_{GSS}	Gate-to-Source Leakage Current	$V_{GS} = \pm 16 \text{ V}$		-	-	± 100	nA	
ON CHARACTERISTICS								
$V_{GS(\text{th})}$	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		
DYNAMIC CHARACTERISTICS								
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	-	Ω	
$Q_{g(\text{tot})}$	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	-		
SWITCHING CHARACTERISTICS								
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		
DRAIN-SOURCE DIODE CHARACTERISTICS								
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		
Q_{rr}	Reverse Recovery Charge							

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.

4. The maximum value is specified by design at $T_J = 175^\circ\text{C}$. Product is not tested to this condition in production

TYPICAL CHARACTERISTICS

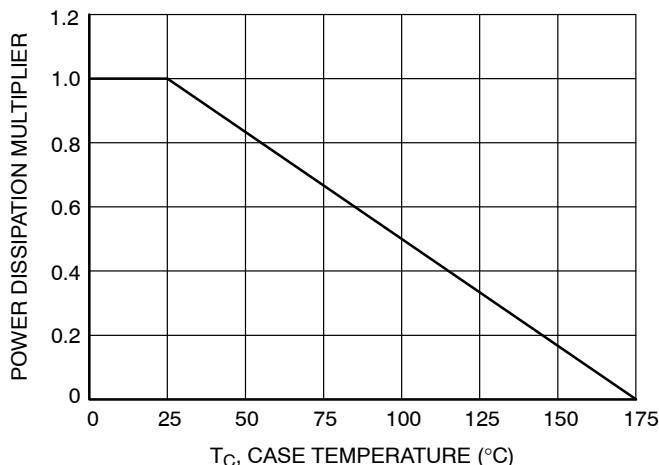


Figure 1. Normalized Power Dissipation vs.
Case Temperature

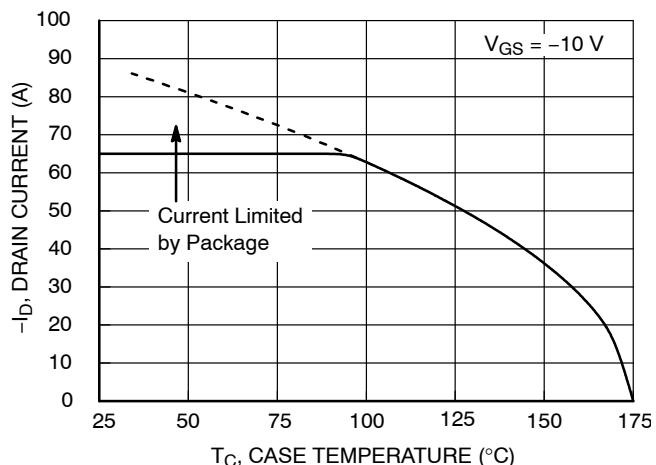


Figure 2. Maximum Continuous Drain Current vs.
Case Temperature

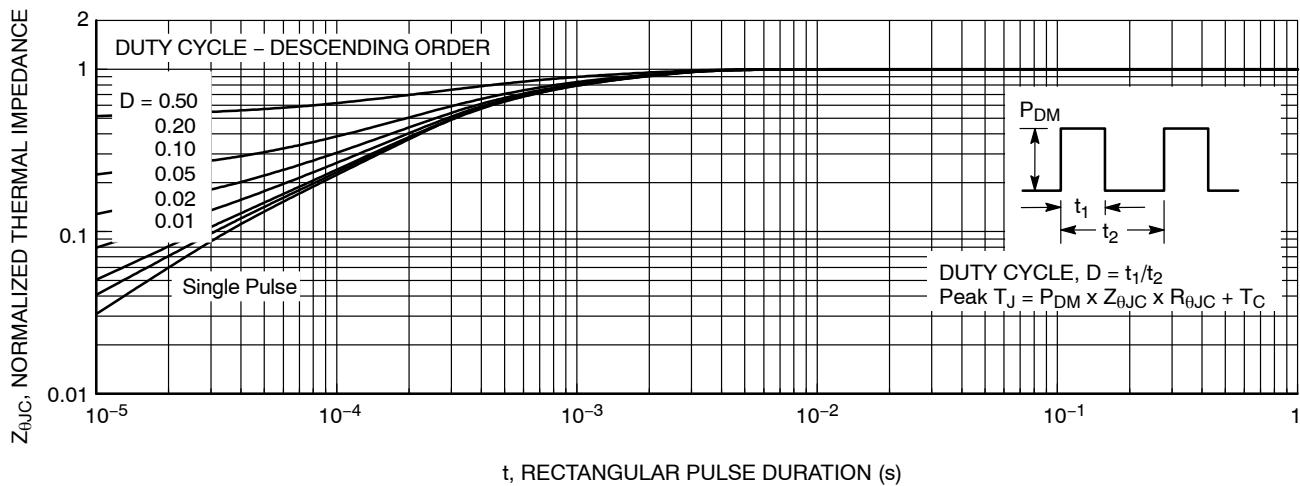


Figure 3. Normalized Maximum Transient Thermal Impedance

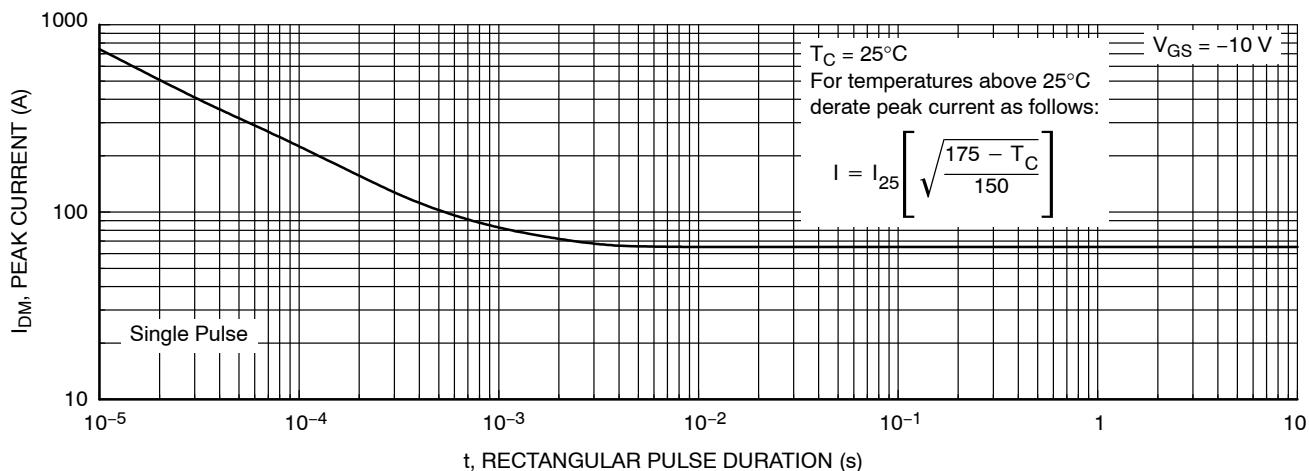


Figure 4. Peak Current Capability

TYPICAL CHARACTERISTICS (continued)

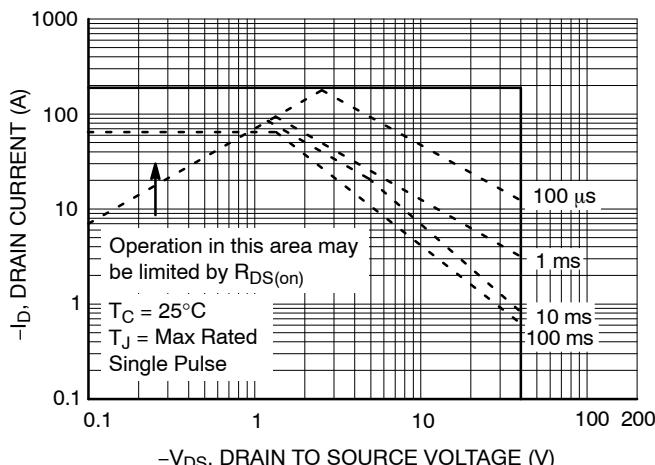


Figure 5. Forward Bias Safe Operating Area

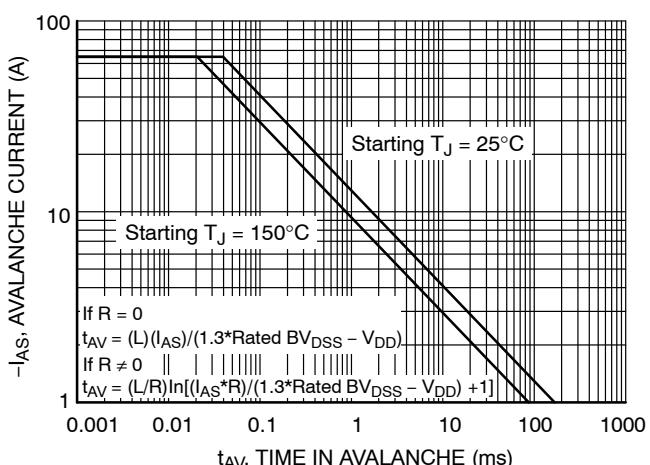


Figure 6. Unclamped Inductive Switching Capability

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

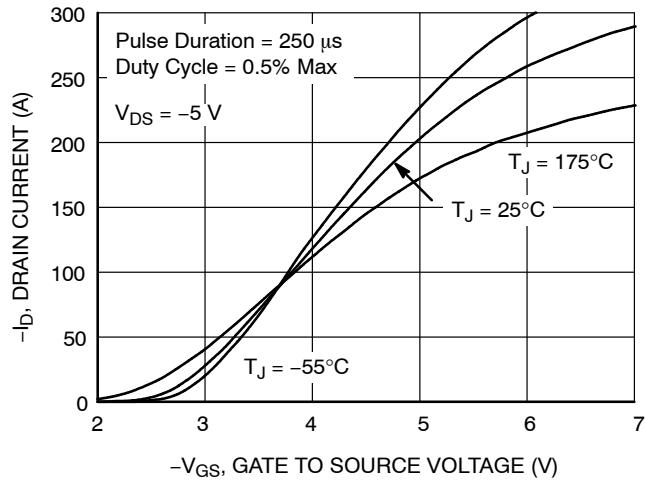


Figure 7. Transfer Characteristics

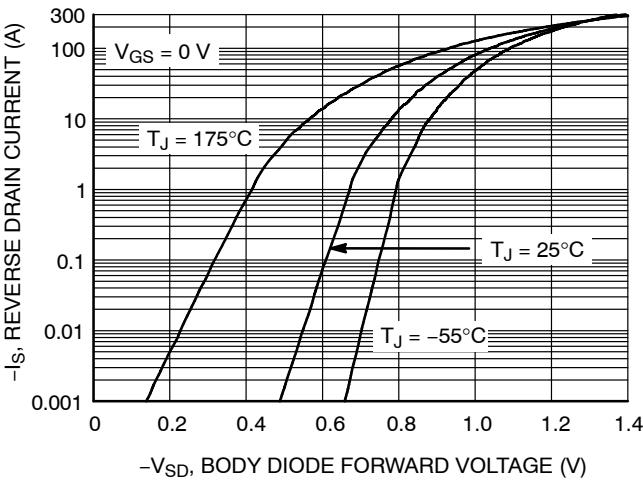


Figure 8. Forward Diode Characteristics

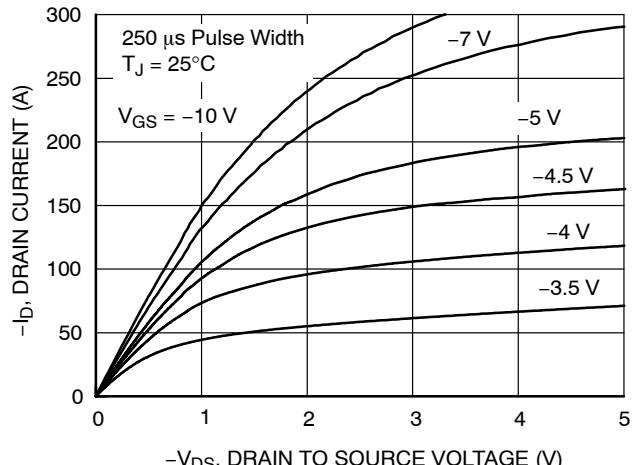


Figure 9. Saturation Characteristics

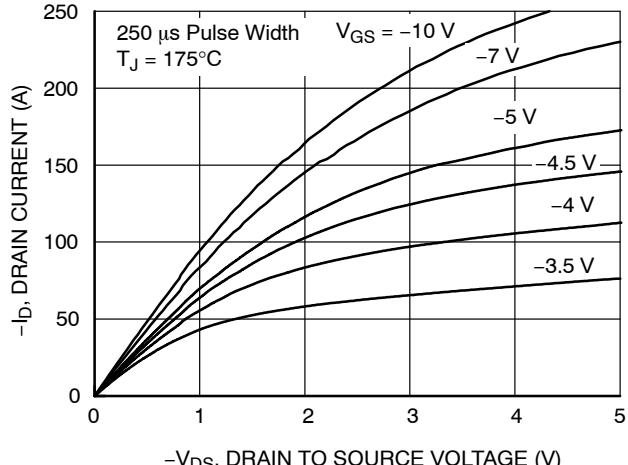


Figure 10. Saturation Characteristics

TYPICAL CHARACTERISTICS (continued)

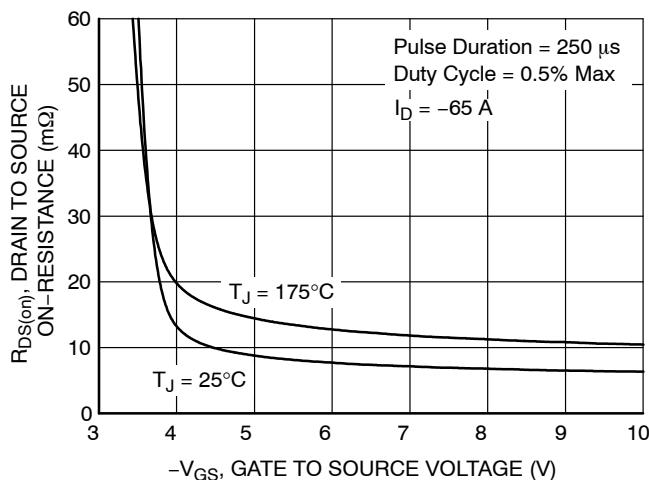
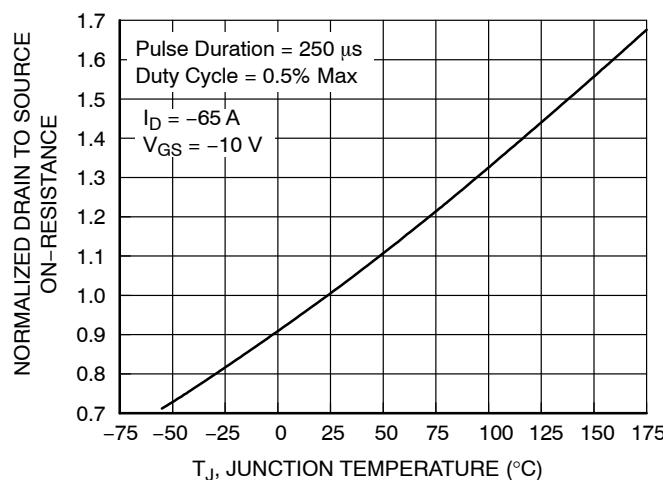
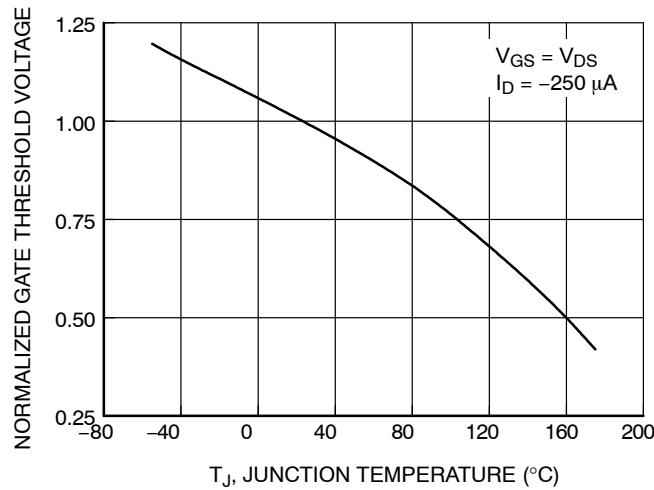
Figure 11. $R_{D\text{S(on)}}$ vs. Gate VoltageFigure 12. Normalized $R_{D\text{S(on)}}$ vs. Junction Temperature

Figure 13. Normalized Gate Threshold Voltage vs. Temperature

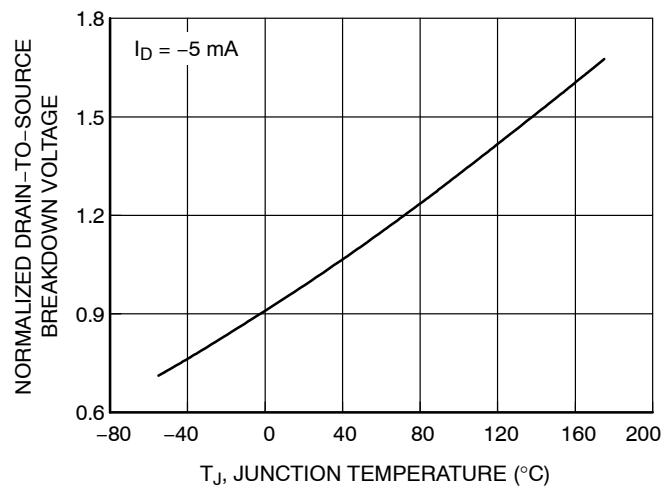


Figure 14. Normalized Drain to Source Breakdown Voltage vs. Junction Temperature

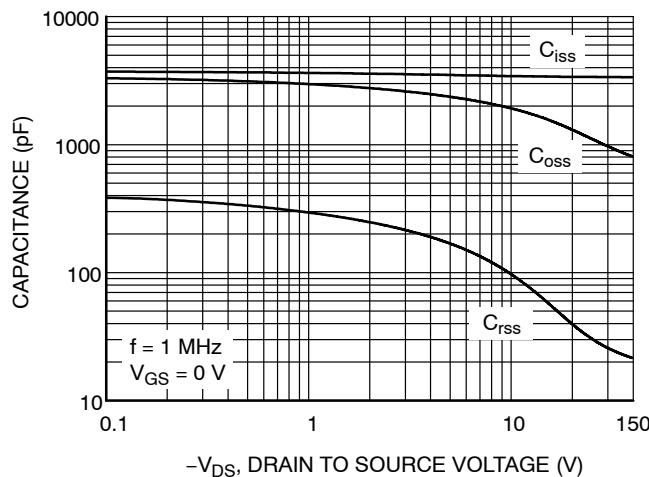


Figure 15. Capacitance vs. Drain to Source Voltage

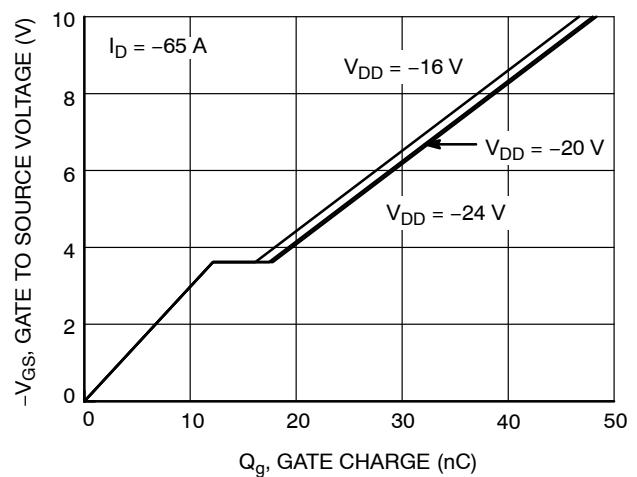
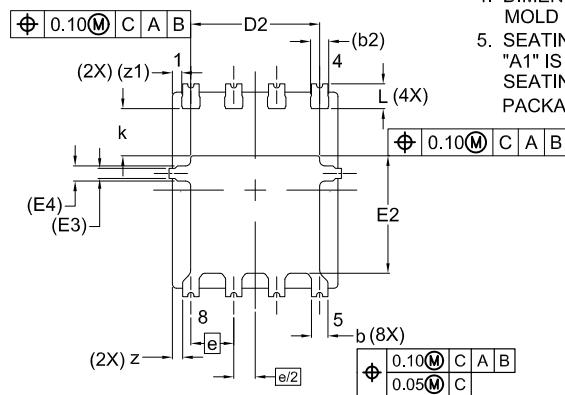
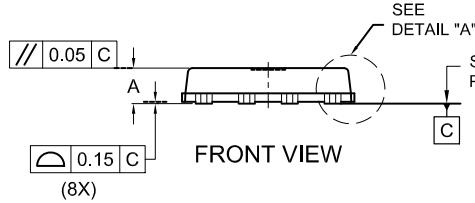
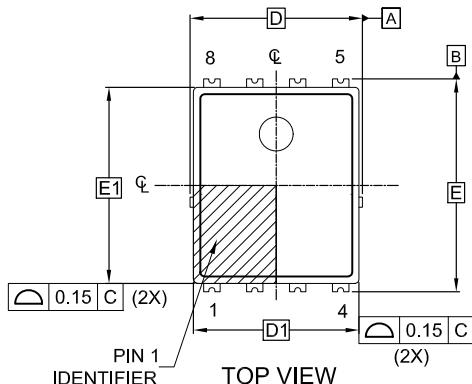


Figure 16. Gate Charge vs. Gate to Source Voltage

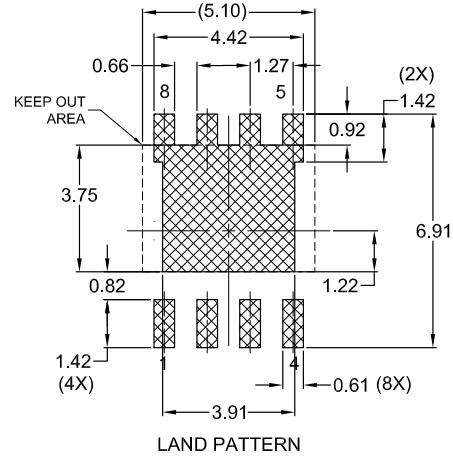
PACKAGE DIMENSIONS

DFNW8 5.2x6.3, 1.27P

CASE 507AU
ISSUE A

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.



*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM.D.

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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