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# MOSFET - Power, Single P-Channel

## -40 V, 2.2 mΩ, -222 A



ON Semiconductor®

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## NVMFS2D3P04M8L

### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- High Current Capability
- Avalanche Energy Specified
- NVMFWS2D3P04M8L – Wettable Flanks Product
- NVM Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### 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	$V_{GS}$	$\pm 20$	V	
Continuous Drain Current $R_{\theta JC}$ (Notes 1, 2, 3)	Steady State	$T_C = 25^\circ\text{C}$	$I_D$ -222	A
		$T_C = 100^\circ\text{C}$	-157	
Power Dissipation $R_{\theta JC}$ (Notes 1, 2)	Steady State	$T_C = 25^\circ\text{C}$	$P_D$ 205	W
		$T_C = 100^\circ\text{C}$	103	
Continuous Drain Current $R_{\theta JA}$ (Notes 1, 2, 3)	Steady State	$T_A = 25^\circ\text{C}$	$I_D$ -31	A
		$T_A = 100^\circ\text{C}$	-22	
Power Dissipation $R_{\theta JA}$ (Notes 1, 2)	Steady State	$T_A = 25^\circ\text{C}$	$P_D$ 3.8	W
		$T_A = 100^\circ\text{C}$	1.9	
Pulsed Drain Current	$T_A = 25^\circ\text{C}, t_p = 10 \mu\text{s}$	$I_{DM}$ -900	A	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +175	$^\circ\text{C}$	
Source Current (Body Diode)	$I_S$	-171	A	
Single Pulse Drain-to-Source Avalanche Energy ( $I_{L(pk)} = 40 \text{ A}$ )	$E_{AS}$	1516	mJ	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)	$T_L$	260	$^\circ\text{C}$	

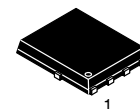
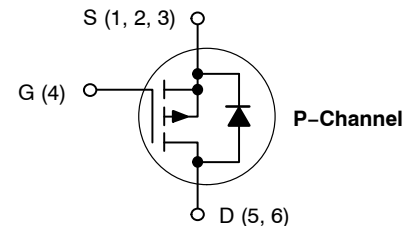
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case – Steady State (Drain) (Note 2)	$R_{\theta JC}$	0.7	$^\circ\text{C}/\text{W}$
Junction-to-Ambient – Steady State (Note 2)	$R_{\theta JA}$	39	$^\circ\text{C}/\text{W}$

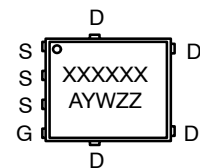
1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
2. Surface-mounted on FR4 board using a 650 mm<sup>2</sup>, 2 oz. Cu pad.
3. Continuous DC current rating. Maximum current for pulses as long as 1 second is higher but is dependent on pulse duration and duty cycle.

$V_{(BR)DSS}$	$R_{DS(on)}$	$I_D$
-40 V	2.2 mΩ @ -10 V	-222 A
	3.3 mΩ @ -4.5 V	



DFN5/DFNW5  
CASES 506EZ/507AZ

### MARKING DIAGRAM



- A = Assembly Location
- Y = Year
- W = Work Week
- ZZ = Lot Traceability

### ORDERING INFORMATION

See detailed ordering, marking and shipping information on page 5 of this data sheet.

# NVMFS2D3P04M8L

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage	V <sub>(BR)DSS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA	-40			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	V <sub>(BR)DSS</sub> /T <sub>J</sub>			9		mV/°C
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = -40 V	T <sub>J</sub> = 25°C		-1.0	μA
			T <sub>J</sub> = 125°C		-100	
Gate-to-Source Leakage Current	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±20 V			±100	nA

## ON CHARACTERISTICS (Note 4)

Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = -2.7 mA	-0.7		-2.4	V
Negative Threshold Temperature Coefficient	V <sub>GS(TH)</sub> /T <sub>J</sub>			-4.6		mV/°C
Drain-to-Source On Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = -10 V, I <sub>D</sub> = -30 A		1.6	2.2	mΩ
		V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -10 A		2.1	3.3	
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> = -24 V, I <sub>D</sub> = -75 A		250		S

## CHARGES AND CAPACITANCES

Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V, f = 1.0 MHz, V <sub>DS</sub> = -20 V		5985		pF
Output Capacitance	C <sub>oss</sub>			4228		
Reverse Transfer Capacitance	C <sub>rss</sub>			88		
Total Gate Charge	Q <sub>G(TOT)</sub>	V <sub>DS</sub> = -20 V, I <sub>D</sub> = -50 A	V <sub>GS</sub> = -4.5 V	73.5		nC
			V <sub>GS</sub> = -10 V	157		
Threshold Gate Charge	Q <sub>G(TH)</sub>	V <sub>GS</sub> = -10 V, V <sub>DS</sub> = -20 V, I <sub>D</sub> = -50 A		13.9		V
Gate-to-Source Charge	Q <sub>GS</sub>			26.2		
Gate-to-Drain Charge	Q <sub>GD</sub>			17.8		
Plateau Voltage	V <sub>GP</sub>			2.53		

## SWITCHING CHARACTERISTICS (Notes 4)

Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>GS</sub> = -4.5 V, V <sub>DS</sub> = -20 V, I <sub>D</sub> = -50 A, R <sub>G</sub> = 2.5 Ω		16.3		ns
Rise Time	t <sub>r</sub>			57.4		
Turn-Off Delay Time	t <sub>d(off)</sub>			508		
Fall Time	t <sub>f</sub>			373		

## DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = -15 A	T <sub>J</sub> = 25°C		-0.72	-1.2	V
			T <sub>J</sub> = 125°C		-0.57		
Reverse Recovery Time	t <sub>RR</sub>	V <sub>GS</sub> = 0 V, di/dt = 100 A/μs, I <sub>S</sub> = -50 A		159		ns	
Charge Time	t <sub>a</sub>			94.6			
Discharge Time	t <sub>b</sub>			81.7			
Reverse Recovery Charge	Q <sub>RR</sub>			536			nC

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. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

# NVMFS2D3P04M8L

## TYPICAL CHARACTERISTICS

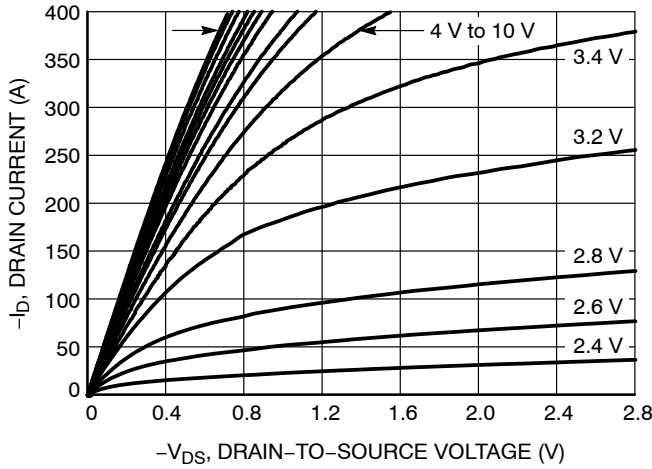


Figure 1. On-Region Characteristics

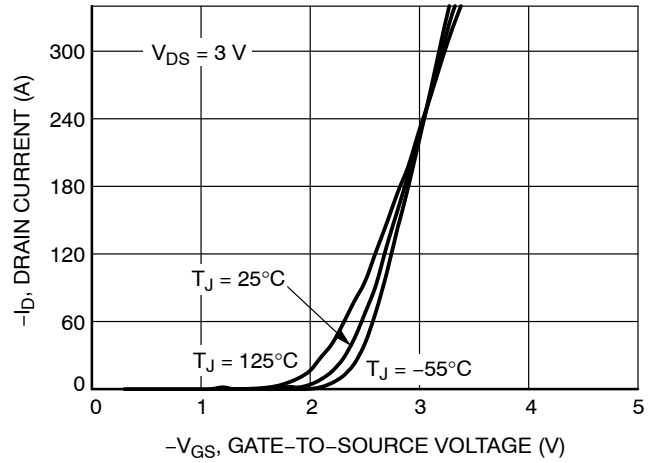


Figure 2. Transfer Characteristics

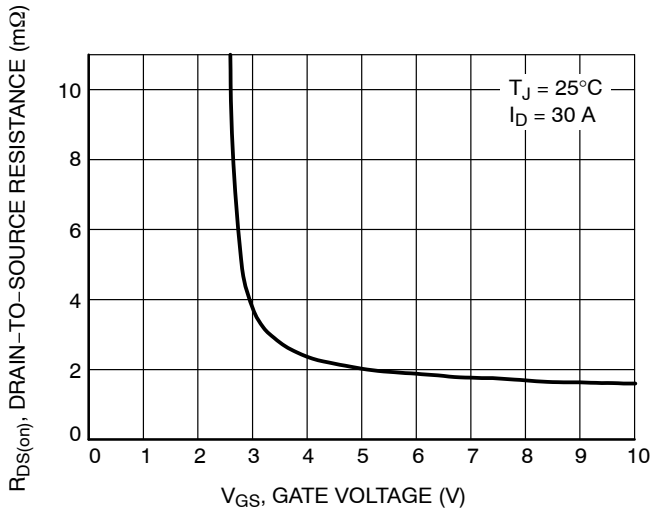


Figure 3. On-Resistance vs. Gate-to-Source Voltage

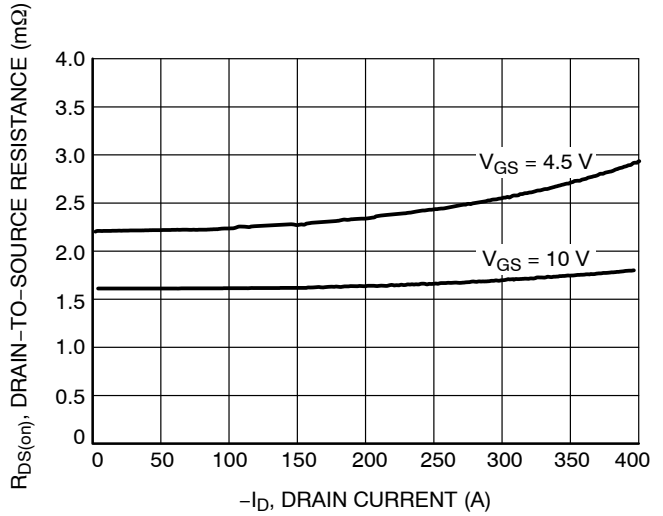


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

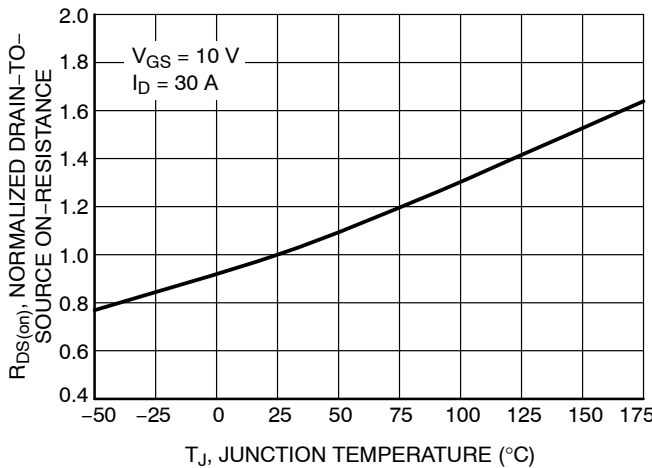


Figure 5. On-Resistance Variation with Temperature

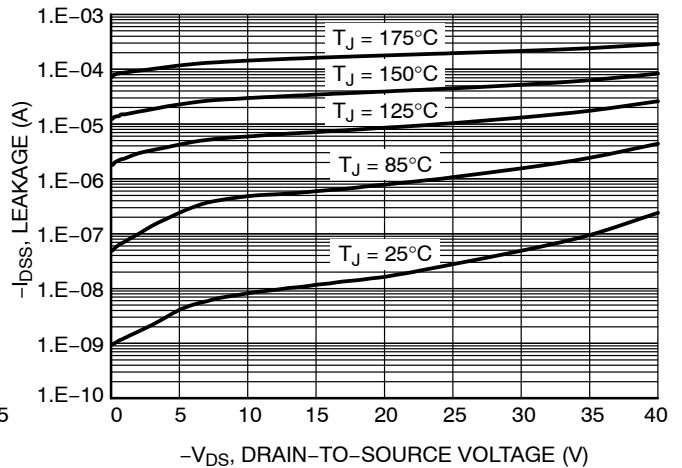


Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NVMFS2D3P04M8L

## TYPICAL CHARACTERISTICS

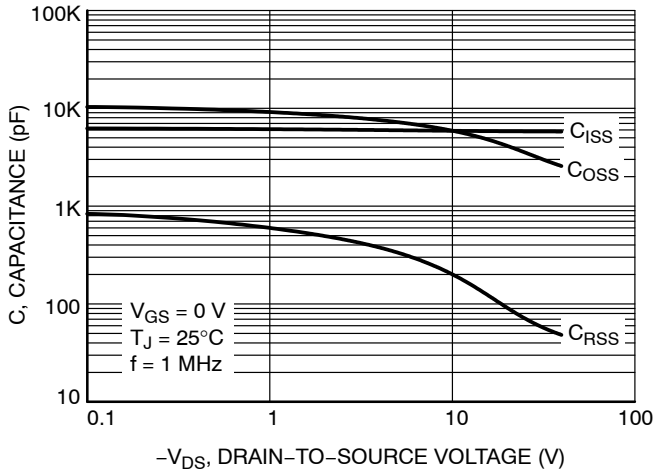


Figure 7. Capacitance Variation

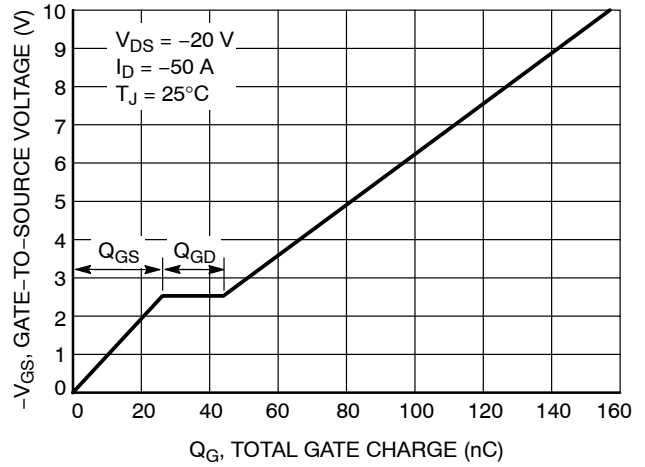


Figure 8. Gate-to-Source vs. Total Gate Charge

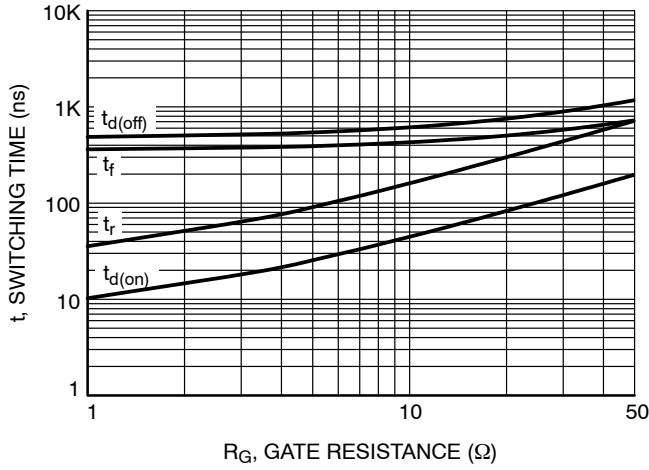


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

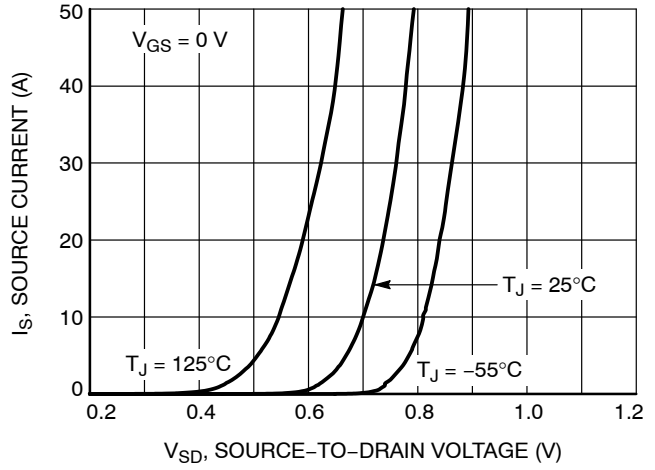


Figure 10. Diode Forward Voltage vs. Current

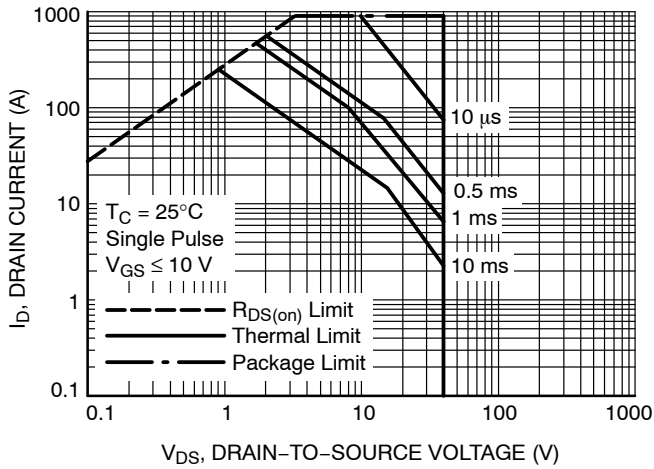


Figure 11. Maximum Rated Forward Biased Safe Operating Area

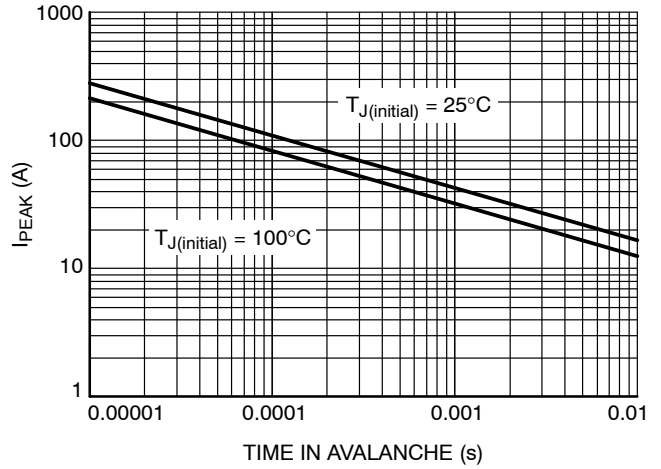


Figure 12.  $I_{PEAK}$  vs. Time in Avalanche

# NVMFS2D3P04M8L

## TYPICAL CHARACTERISTICS

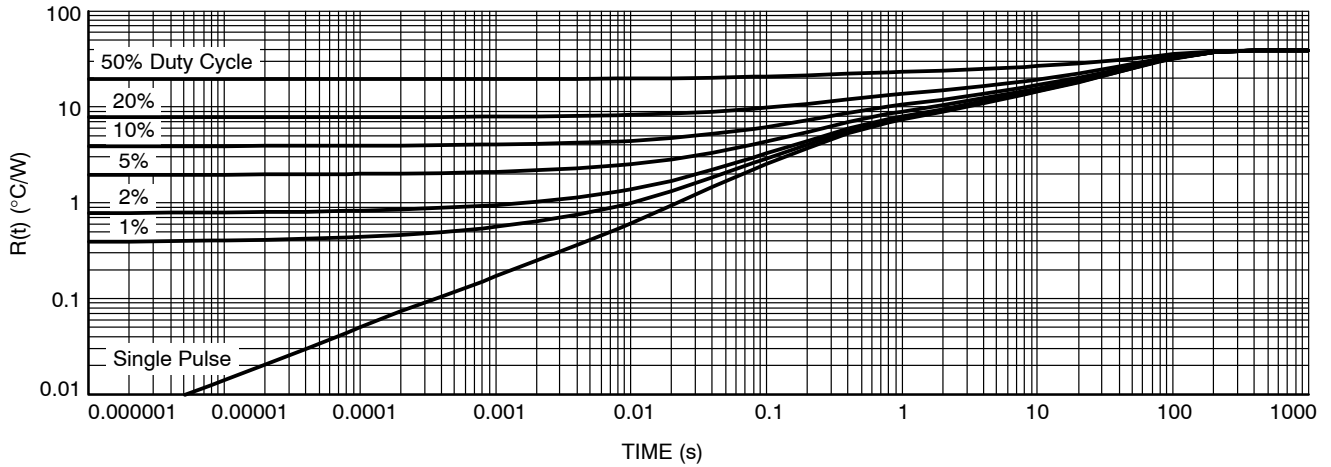


Figure 13. Thermal Response

### DEVICE ORDERING INFORMATION

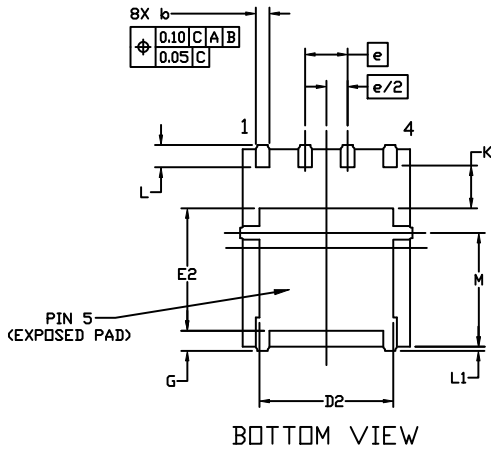
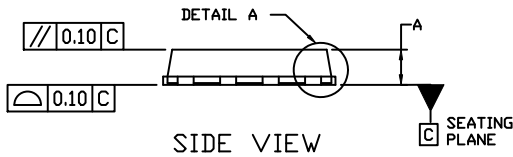
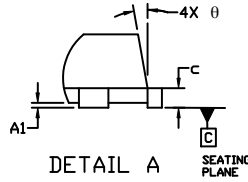
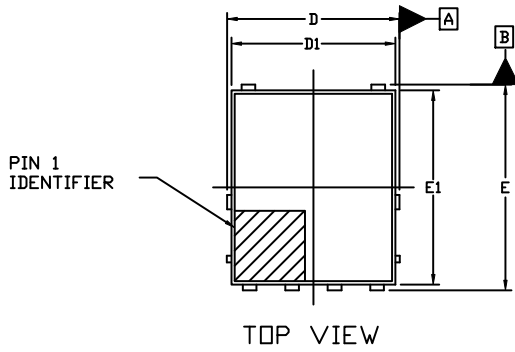
Device	Marking	Package	Shipping†
NVMFS2D3P04M8LT1G	2D3P04	CASE 506EZ, DFN5 (Pb-Free)	1500 / Tape & Reel
NVMFWS2D3P04M8LT1G	2D3P4W	CASE 507AZ, DFNW5 (Pb-Free)	1500 / Tape & Reel

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

# NVMFS2D3P04M8L

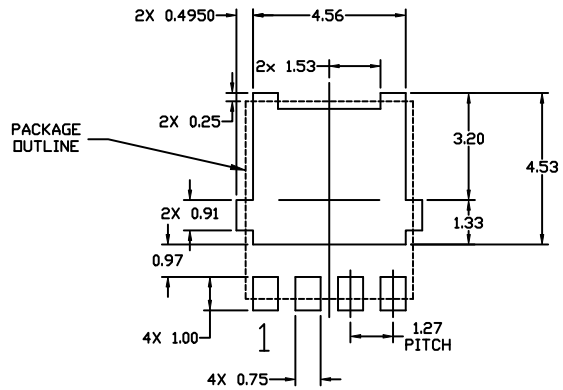
## PACKAGE DIMENSIONS

DFN5 5x6, 1.27P (SO-8FL)  
CASE 506EZ  
ISSUE O



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
  2. CONTROLLING DIMENSION: MILLIMETERS
  3. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.90	1.00	1.10
A1	0.00	---	0.05
b	0.33	0.41	0.51
c	0.23	0.28	0.33
D	5.00	5.15	5.30
D1	4.70	4.90	5.10
D2	3.80	4.00	4.20
E	6.00	6.15	6.30
E1	5.70	5.90	6.10
E2	3.45	3.65	3.85
e	1.27 BSC		
G	0.51	0.575	0.71
k	1.10	1.20	1.40
L	0.51	0.575	0.71
L1	1.25 REF		
M	3.00	3.40	3.80
θ	0°	---	12°



### RECOMMENDED MOUNTING FOOTPRINT

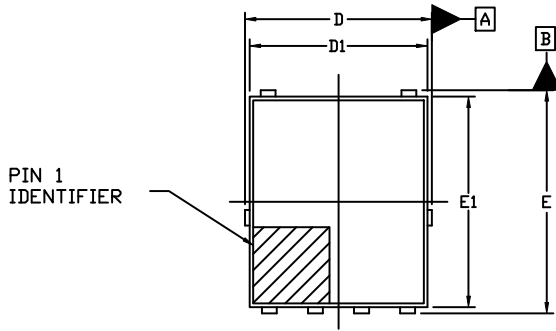
- \* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.

# NVMFS2D3P04M8L

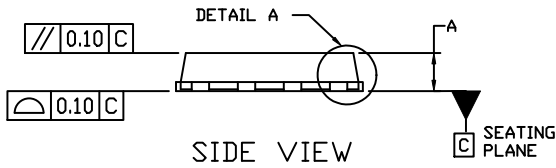
## PACKAGE DIMENSIONS

DFNW5 5x6 (SO8FL HE WF)  
CASE 507AZ  
ISSUE O

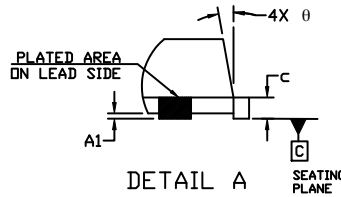
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
  2. CONTROLLING DIMENSION: MILLIMETERS
  3. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.
  4. THIS PACKAGE CONTAINS WETTABLE FLANK DESIGN FEATURES TO AID IN FILLET FORMATION ON THE LEADS DURING MOUNTING.



TOP VIEW

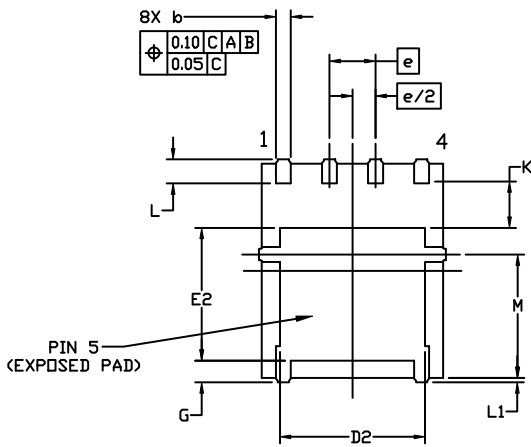


SIDE VIEW

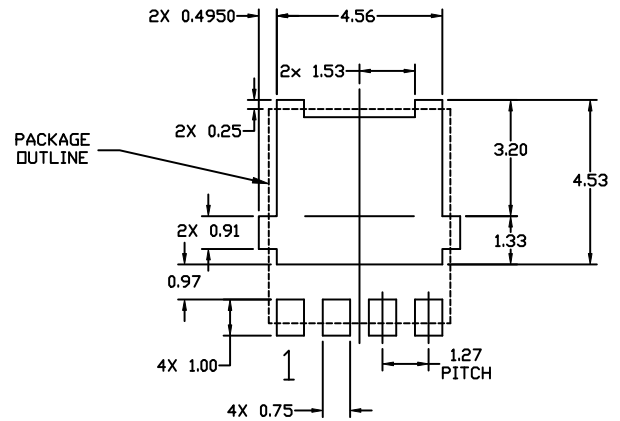


DETAIL A

MILLIMETERS			
DIM	MIN.	NOM.	MAX.
A	0.90	1.00	1.10
A1	0.00	---	0.05
b	0.33	0.41	0.51
c	0.23	0.28	0.33
D	5.00	5.15	5.30
D1	4.70	4.90	5.10
D2	3.80	4.00	4.20
E	6.00	6.15	6.30
E1	5.70	5.90	6.10
E2	3.45	3.65	3.85
e	1.27 BSC		
G	0.51	0.575	0.71
k	1.10	1.20	1.40
L	0.51	0.575	0.71
L1	1.25 REF		
M	3.00	3.40	3.80
theta	0°	---	12°



BOTTOM VIEW



### RECOMMENDED MOUNTING FOOTPRINT

\* For additional information on our Pb-Free strategy and soldering details, please download the DN Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.



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