# MOSFET – Power, Single N-Channel, $\mu$ 8FL 30 V, 9.4 m $\Omega$ , 40 A

#### **Features**

- Low R<sub>DS(on)</sub> to Minimize Conduction Losses
- Low Capacitance to Minimize Driver Losses
- Optimized Gate Charge to Minimize Switching Losses
- NVTFS4C13NWF Wettable Flanks Product
- NVT 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<sub>J</sub> = 25°C unless otherwise stated)

Param	Symbol	Value	Unit		
Drain-to-Source Voltage			$V_{DSS}$	30	V
Gate-to-Source Voltage			V <sub>GS</sub>	±20	V
Continuous Drain Current R <sub>0.IA</sub>		T <sub>A</sub> = 25°C	I <sub>D</sub>	14	Α
(Notes 1, 2, 4)		T <sub>A</sub> = 100°C		10	
Power Dissipation R <sub>θJA</sub>		T <sub>A</sub> = 25°C	$P_{D}$	3.0	W
(Note 1, 2, 4)	Steady	T <sub>A</sub> = 100°C		1.5	
Continuous Drain Current R <sub>0JC</sub> (Note 1,	State	T <sub>C</sub> = 25°C	I <sub>D</sub>	40	
3, 4)		T <sub>C</sub> = 100°C		28	Α
Power Dissipation		T <sub>C</sub> = 25°C	$P_{D}$	26	W
R <sub>θJC</sub> (Note 1, 3, 4)		T <sub>C</sub> = 100°C		13	
Pulsed Drain Current	T <sub>A</sub> = 25°0	C, t <sub>p</sub> = 10 μs	I <sub>DM</sub>	152	Α
Operating Junction and Storage Temperature			T <sub>J</sub> , T <sub>stg</sub>	–55 to +175	°C
Source Current (Body Diode)			I <sub>S</sub>	24	Α
Single Pulse Drain-to-Source Avalanche Energy ( $T_J = 25$ °C, $I_L = 14 A_{pk}$ , $L = 0.1 mH$ )			E <sub>AS</sub>	10	mJ
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)			TL	260	°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) (Notes 1 and 4)	$R_{\theta JC}$	5.8	°C/W
Junction-to-Ambient - Steady State (Notes 1 and 2)	$R_{\theta JA}$	50	0/11

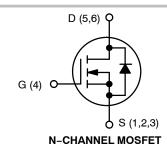
- The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
- 2. Surface-mounted on FR4 board using a 650 mm<sup>2</sup> 2 oz. Cu pad.
- Assumes heat-sink sufficiently large to maintain constant case temperature independent of device power.
- Continuous DC current rating. Maximum current for pulses as long as 1 second is higher but is dependent on pulse duration and duty cycle.



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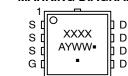
V <sub>(BR)DSS</sub>	R <sub>DS(ON)</sub> MAX	I <sub>D</sub> MAX	
30 V	9.4 mΩ @ 10 V	40 A	
30 V	14 mΩ @ 4.5 V	40 (	





CASE 511AB

#### **MARKING DIAGRAM**



4C13 = Specific Device Code for

NVMTS4C13N

13WF = Specific Device Code of

NVTFS4C13NWF

A = Assembly Location

Y = Year WW = Work Week • Pb-Free Package

(Note: Microdot may be in either location)

#### **ORDERING INFORMATION**

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

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

Parameter	Symbol	Test Condition		Min	Тур	Max	Unit	
OFF CHARACTERISTICS	-			-	-	-	-	
Drain-to-Source Breakdown Voltage	V <sub>(BR)DSS</sub>	$V_{GS} = 0 \text{ V}, I_D = 250 \mu\text{A}$		30			V	
Drain-to-Source Breakdown Voltage Temperature Coefficient	V <sub>(BR)DSS</sub> /				14.9		mV/°C	
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V,	T <sub>J</sub> = 25°C			1.0	μΑ	
		V <sub>DS</sub> = 24 V	T <sub>J</sub> = 125°C			10		
Gate-to-Source Leakage Current	I <sub>GSS</sub>	$V_{DS} = 0 V, V_{GS}$	= ±20 V			±100	nA	
ON CHARACTERISTICS (Note 5)								
Gate Threshold Voltage	V <sub>GS(TH)</sub>	$V_{GS} = V_{DS}, I_D =$	= 250 μΑ	1.3		2.1	V	
Negative Threshold Temperature Coefficient	V <sub>GS(TH)</sub> /T <sub>J</sub>				4.8		mV/°C	
Drain-to-Source On Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V	I <sub>D</sub> = 30 A		7.5	9.4		
		V <sub>GS</sub> = 4.5 V	I <sub>D</sub> = 12 A		11.2	14	mΩ	
Forward Transconductance	9 <sub>FS</sub>	V <sub>DS</sub> = 1.5 V, I <sub>D</sub>	) = 15 A		40		S	
Gate Resistance	$R_{G}$	T <sub>A</sub> = 25°	С		1.0		Ω	
CHARGES AND CAPACITANCES								
Input Capacitance	C <sub>ISS</sub>				770		pF	
Output Capacitance	Coss	V <sub>GS</sub> = 0 V, f = 1 MH:	z, V <sub>DS</sub> = 15 V		443			
Reverse Transfer Capacitance	C <sub>RSS</sub>				127			
Capacitance Ratio	C <sub>RSS</sub> /C <sub>ISS</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 15 V, f = 1 MHz			0.165			
Total Gate Charge	Q <sub>G(TOT)</sub>				7.8		nC	
Threshold Gate Charge	Q <sub>G(TH)</sub>				1.4			
Gate-to-Source Charge	Q <sub>GS</sub>	V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 1	5 V; I <sub>D</sub> = 30 A		2.9			
Gate-to-Drain Charge	$Q_{GD}$				3.7			
Gate Plateau Voltage	$V_{GP}$				3.6		V	
Total Gate Charge	Q <sub>G(TOT)</sub>	V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 15 V; I <sub>D</sub> = 30 A			15.2		nC	
SWITCHING CHARACTERISTICS (Note 6)	. ,					<u> </u>		
Turn-On Delay Time	t <sub>d(ON)</sub>				9			
Rise Time	t <sub>r</sub>	Voc = 4.5 V Voc	a = 15 V		35		ns	
Turn-Off Delay Time	t <sub>d(OFF)</sub>	$V_{GS} = 4.5 \text{ V}, V_{DS}$ $I_D = 15 \text{ A}, R_G = 10 \text{ A}$	$= 3.0 \Omega$		13			
Fall Time	t <sub>f</sub>				5			
Turn-On Delay Time	t <sub>d(ON)</sub>				6.0			
Rise Time	t <sub>r</sub>	Voc - 10 V Vo	a = 15 V		26			
Turn-Off Delay Time	t <sub>d(OFF)</sub>	$V_{GS}$ = 10 V, $V_{DS}$ = 15 V, $I_{D}$ = 15 A, $R_{G}$ = 3.0 $\Omega$			16		ns	
Fall Time	t <sub>f</sub>				3.0			
DRAIN-SOURCE DIODE CHARACTERISTIC	<u> </u>	<u> </u>			<u> </u>	<u> </u>	1	
Forward Diode Voltage	$V_{SD}$	V <sub>GS</sub> = 0 V,	T <sub>J</sub> = 25°C		0.82	1.1		
- -		V <sub>GS</sub> = 0 V, I <sub>S</sub> = 30 A	T <sub>J</sub> = 125°C			٧		
Reverse Recovery Time	t <sub>RR</sub>	V <sub>GS</sub> = 0 V, dIS/dt = 100 A/μs, I <sub>S</sub> = 30 A			23.4			
Charge Time	t <sub>a</sub>				12.1		ns	
Discharge Time	t <sub>b</sub>				11.3			
Reverse Recovery Charge	Q <sub>RR</sub>			<b></b>	9.7	<del>                                     </del>	nC	
	∽nn			l	5.,	l		

- 5. Pulse Test: pulse width  $\leq 300~\mu s$ , duty cycle  $\leq 2\%$ .
  6. Switching characteristics are independent of operating junction temperatures.

#### TYPICAL CHARACTERISTICS

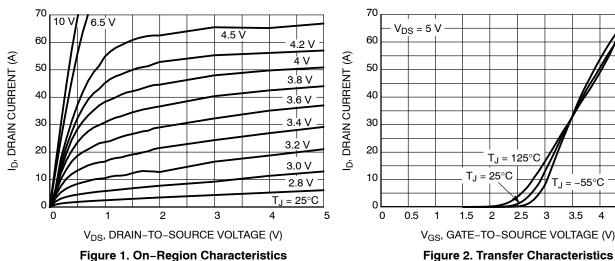
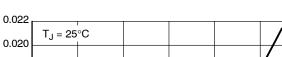


Figure 1. On-Region Characteristics



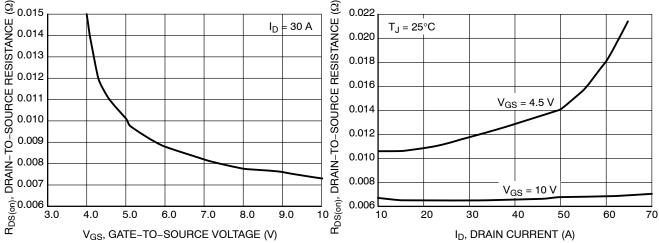


Figure 3. On-Resistance vs. V<sub>GS</sub>

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

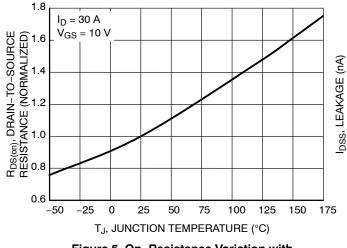


Figure 5. On-Resistance Variation with **Temperature** 

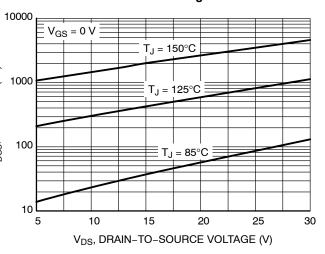


Figure 6. Drain-to-Source Leakage Current vs. Voltage

#### **TYPICAL CHARACTERISTICS**

V<sub>GS</sub>, GATE-TO-SOURCE VOLTAGE (V)

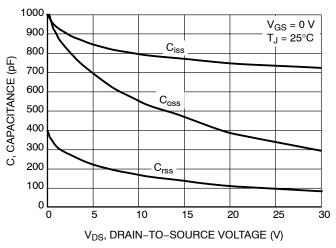


Figure 7. Capacitance Variation

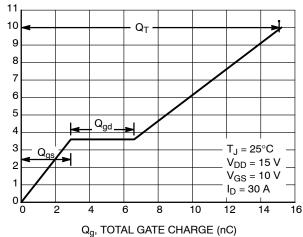


Figure 8. Gate-to-Source and

Drain-to-Source Voltage vs. Total Charge

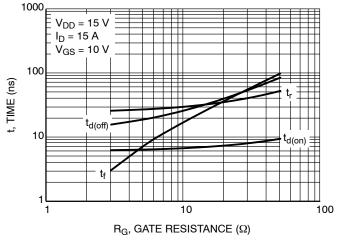


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

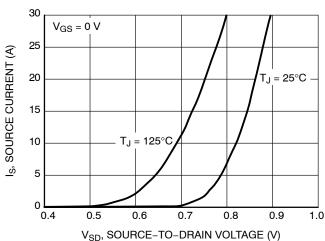


Figure 10. Diode Forward Voltage vs. Current

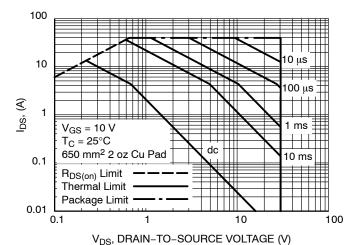


Figure 11. Maximum Rated Forward Biased
Safe Operating Area

## **TYPICAL CHARACTERISTICS**

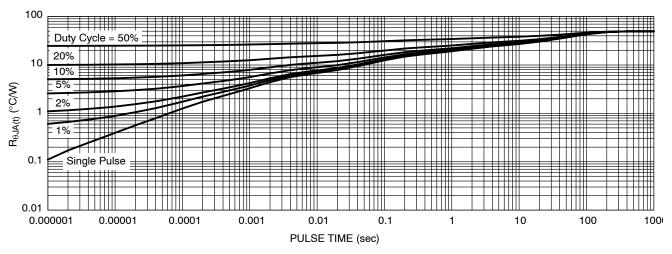


Figure 12. Thermal Response

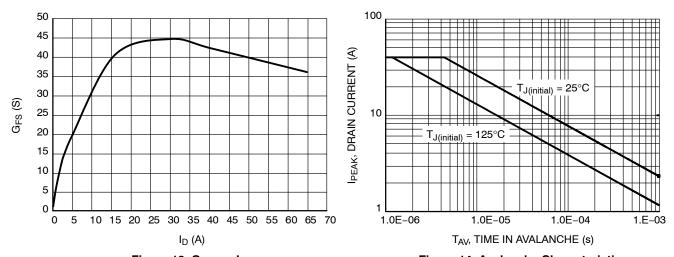


Figure 13.  $G_{FS}$  vs.  $I_D$ 

Figure 14. Avalanche Characteristics

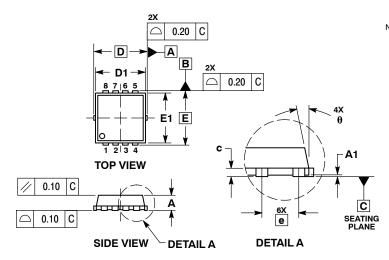
## **ORDERING INFORMATION**

Device	Package	Shipping <sup>†</sup>		
NVTFS4C13NTAG	WDFN8 (Pb-Free)	1500 / Tape & Reel		
NVTFS4C13NWFTAG	WDFN8 (Pb-Free)	1500 / Tape & Reel		
NVTFS4C13NTWG	WDFN8 (Pb-Free)	5000 / Tape & Reel		
NVTFS4C13NWFTWG	WDFN8 (Pb-Free)	5000 / 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 Specifications Brochure, BRD8011/D.

#### PACKAGE DIMENSIONS

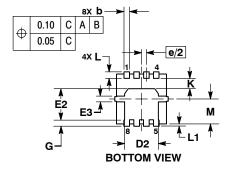
# WDFN8 3.3x3.3, 0.65P CASE 511AB ISSUE D



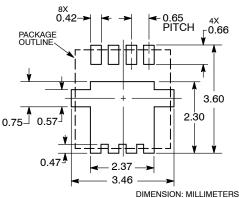
#### NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
   CONTROLLING DIMENSION: MILLIMETERS.
- DIMENSION D1 AND E1 DO NOT INCLUDE MOLD FLASH PROTRUSIONS OR GATE BURRS.

	MILLIMETERS			INCHES			
DIM	MIN	NOM	MAX	MIN	NOM	MAX	
Α	0.70	0.75	0.80	0.028	0.030	0.031	
A1	0.00		0.05	0.000		0.002	
b	0.23	0.30	0.40	0.009	0.012	0.016	
С	0.15	0.20	0.25	0.006	0.008	0.010	
D	3.30 BSC			0.130 BSC			
D1	2.95	3.05	3.15	0.116	0.120	0.124	
D2	1.98	2.11	2.24	0.078	0.083	0.088	
E		3.30 BSC	;	0.130 BSC			
E1	2.95	3.05	3.15	0.116	0.120	0.124	
E2	1.47	1.60	1.73	0.058	0.063	0.068	
E3	0.23	0.30	0.40	0.009	0.012	0.016	
е	0.65 BSC			0.026 BSC			
G	0.30	0.41	0.51	0.012	0.016	0.020	
K	0.65	0.80	0.95	0.026	0.032	0.037	
L	0.30	0.43	0.56	0.012	0.017	0.022	
L1	0.06	0.13	0.20	0.002	0.005	0.008	
M	1.40	1.50	1.60	0.055	0.059	0.063	
θ	0 °		12 °	0 °		12 °	



#### **SOLDERING FOOTPRINT\***



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

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