

# MOSFET - Power, Single N-Channel, $\mu$ 8FL

## 30 V, 17 m $\Omega$ , 22 A

### NVTFS4C25N

#### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low Capacitance to Minimize Driver Losses
- Optimized Gate Charge to Minimize Switching Losses
- NVTFS4C25NWF – 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 ( $T_J = 25^\circ\text{C}$ unless otherwise stated)

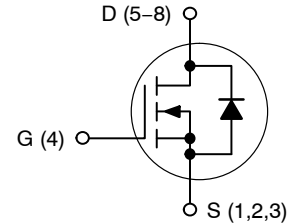
Parameter	Symbol	Value	Unit	
Drain-to-Source Voltage	$V_{DSS}$	30	V	
Gate-to-Source Voltage	$V_{GS}$	$\pm 20$	V	
Continuous Drain Current $R_{\theta JA}$ (Notes 1, 3, 5)	Steady State	$T_A = 25^\circ\text{C}$	$I_D$ 10.1	A
		$T_A = 85^\circ\text{C}$	7.8	
Power Dissipation $R_{\theta JA}$ (Notes 1, 3, 5)		$T_A = 25^\circ\text{C}$	$P_D$ 3.0	W
		$T_A = 85^\circ\text{C}$	1.8	
Continuous Drain Current $R_{\theta JC}$ (Notes 1, 2, 4, 5)	Steady State	$T_C = 25^\circ\text{C}$	$I_D$ 22.1	A
		$T_C = 85^\circ\text{C}$	17.1	
Power Dissipation $R_{\theta JC}$ (Notes 1, 2, 4, 5)		$T_C = 25^\circ\text{C}$	$P_D$ 14.3	W
		$T_C = 85^\circ\text{C}$	8.6	
Pulsed Drain Current	$T_A = 25^\circ\text{C}, t_p = 10 \mu\text{s}$	$I_{DM}$ 90	A	
Operating Junction and Storage Temperature	$T_J, T_{stg}$	-55 to +175	$^\circ\text{C}$	
Source Current (Body Diode)	$I_S$	14	A	
Single Pulse Drain-to-Source Avalanche Energy ( $T_J = 25^\circ\text{C}, I_L = 6.7 A_{pk}, L = 0.5 \text{ mH}$ )	$E_{AS}$	11.2	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.

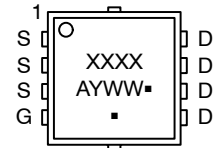
1. The entire application environment impacts the thermal resistance values shown; they are not constants and are valid for the specific conditions noted.
2. Psi ( $\psi$ ) is used as required per JESD51-12 for packages in which substantially less than 100% of the heat flows to a single case surface.
3. Surface-mounted on FR4 board using 650 mm<sup>2</sup>, 2 oz. Cu Pad.
4. Assumes heat-sink sufficiently large to maintain constant case temperature independent of device power.
5. Continuous DC current rating. Maximum current for pulses as long as one second is higher but dependent on pulse duration and duty cycle.

$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	$I_D$ MAX
30 V	17 m $\Omega$ @ 10 V	22 A
	26.5 m $\Omega$ @ 4.5 V	

#### N-Channel MOSFET



#### MARKING DIAGRAM



4C25 = Specific Device Code for NVMTS4C25N

25WF = Specific Device Code of NVTFS4C25NWF

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 6 of this data sheet.

# NVTFS4C25N

## THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case (Drain) (Notes 6, 7 and 9)	$\Psi_{\theta JC}$	10.5	°C/W
Junction-to-Ambient – Steady State (Notes 6 and 8)	$R_{\theta JA}$	50	

- The entire application environment impacts the thermal resistance values shown; they are not constants and are valid for the specific conditions noted.
- Psi ( $\psi$ ) is used as required per JESD51-12 for packages in which substantially less than 100% of the heat flows to a single case surface.
- Surface-mounted on FR4 board using 650 mm<sup>2</sup>, 2 oz. Cu Pad.
- Assumes heat-sink sufficiently large to maintain constant case temperature independent of device power.

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	30			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			15.3		mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 24\text{ V}$			1.0	$\mu\text{A}$
		$T_J = 125^\circ\text{C}$			10	
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA

## ON CHARACTERISTICS (Note 10)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	1.3		2.2	V
Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			-4.5		mV/°C
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 10\text{ A}$ $V_{GS} = 4.5\text{ V}, I_D = 9\text{ A}$		13	17	m $\Omega$
				21	26.5	
Forward Transconductance	$g_{FS}$	$V_{DS} = 1.5\text{ V}, I_D = 15\text{ A}$		23		S
Gate Resistance	$R_G$	$T_A = 25^\circ\text{C}$		1.0		$\Omega$

## CHARGES AND CAPACITANCES

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 15\text{ V}$		500		pF
Output Capacitance	$C_{OSS}$			295		
Reverse Transfer Capacitance	$C_{RSS}$			85		
Capacitance Ratio	$C_{RSS}/C_{ISS}$	$V_{GS} = 0\text{ V}, V_{DS} = 15\text{ V}, f = 1\text{ MHz}$		0.170		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}; I_D = 20\text{ A}$		5.1		nC
Threshold Gate Charge	$Q_{G(TH)}$			0.9		
Gate-to-Source Charge	$Q_{GS}$			1.7		
Gate-to-Drain Charge	$Q_{GD}$			2.7		
Gate Plateau Voltage	$V_{GP}$			3.3		V
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}; I_D = 20\text{ A}$		10.3		nC

## SWITCHING CHARACTERISTICS (Note 11)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 10\text{ A}, R_G = 3.0\ \Omega$		8.0		ns
Rise Time	$t_r$			32		
Turn-Off Delay Time	$t_{d(OFF)}$			10		
Fall Time	$t_f$			3.0		
Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}, I_D = 15\text{ A}, R_G = 3.0\ \Omega$		4.0		ns
Rise Time	$t_r$			25		
Turn-Off Delay Time	$t_{d(OFF)}$			13		
Fall Time	$t_f$			2.0		

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

# NVTFS4C25N

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit	
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>							
Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V},$ $I_S = 10\text{ A}$	$T_J = 25^\circ\text{C}$		0.87	1.2	V
			$T_J = 125^\circ\text{C}$		0.75		
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s},$ $I_S = 30\text{ A}$		18.2		ns	
Charge Time	$t_a$			9.8			
Discharge Time	$t_b$			8.4			
Reverse Recovery Charge	$Q_{RR}$			5.7			nC

10. Pulse Test: pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .

11. Switching characteristics are independent of operating junction temperatures.

# NVTFS4C25N

## TYPICAL CHARACTERISTICS

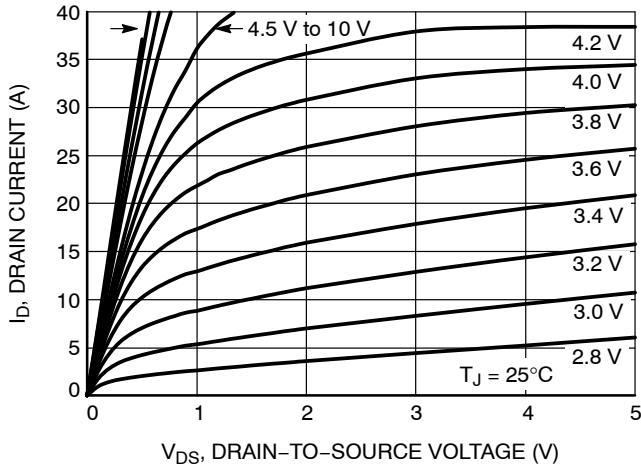


Figure 1. On-Region Characteristics

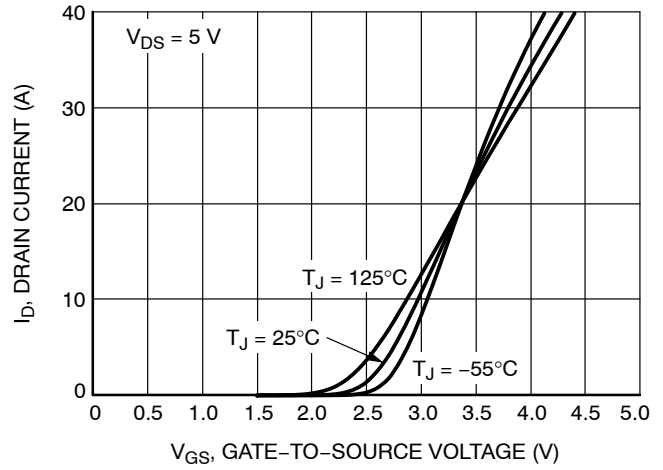


Figure 2. Transfer Characteristics

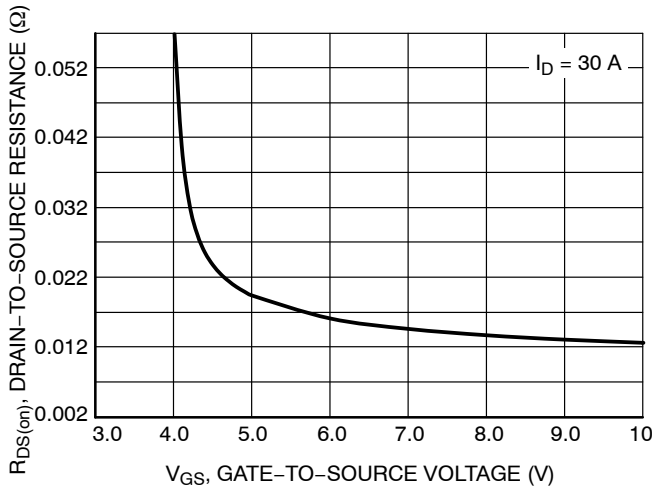


Figure 3. On-Resistance vs.  $V_{GS}$

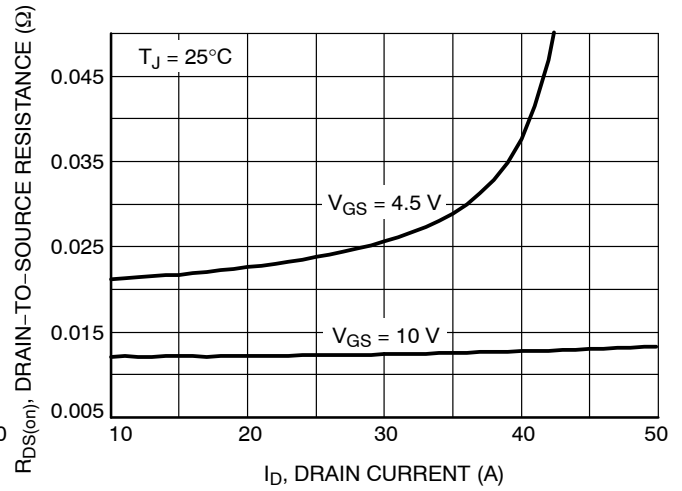


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

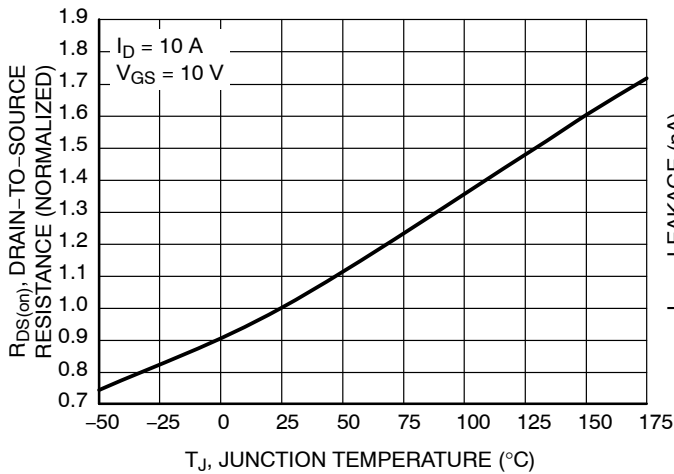


Figure 5. On-Resistance Variation with Temperature

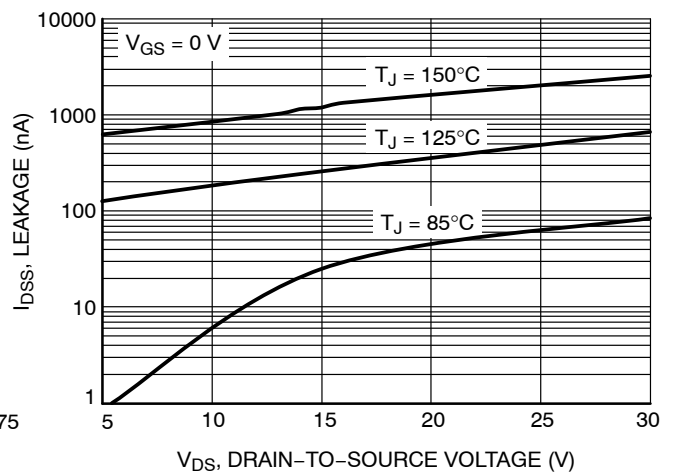


Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NVTFS4C25N

## TYPICAL CHARACTERISTICS

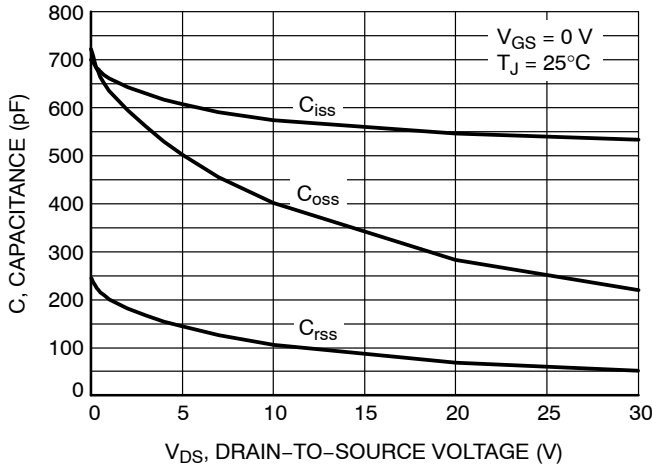


Figure 7. Capacitance Variation

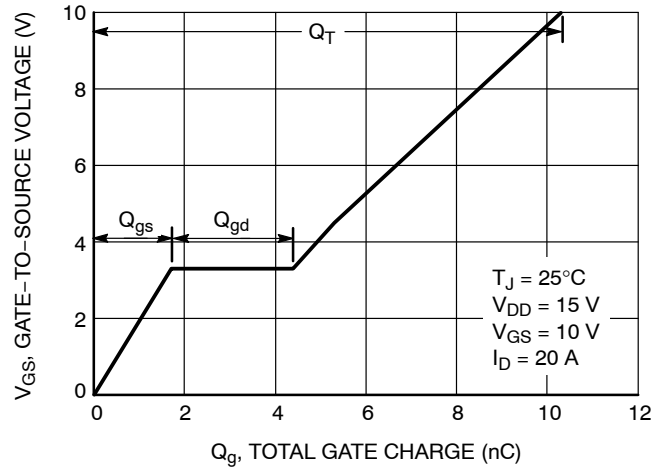


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

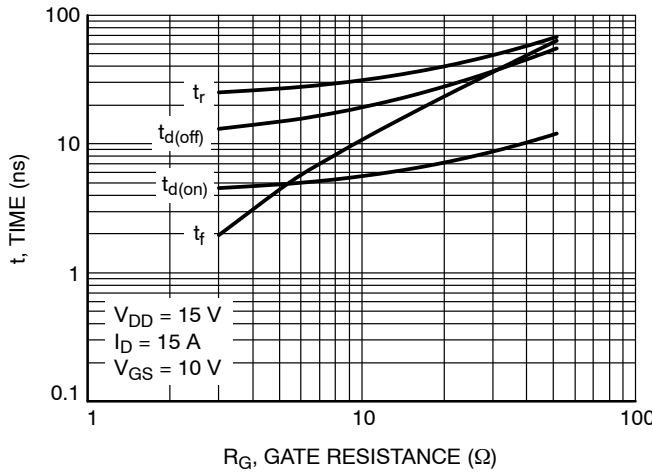


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

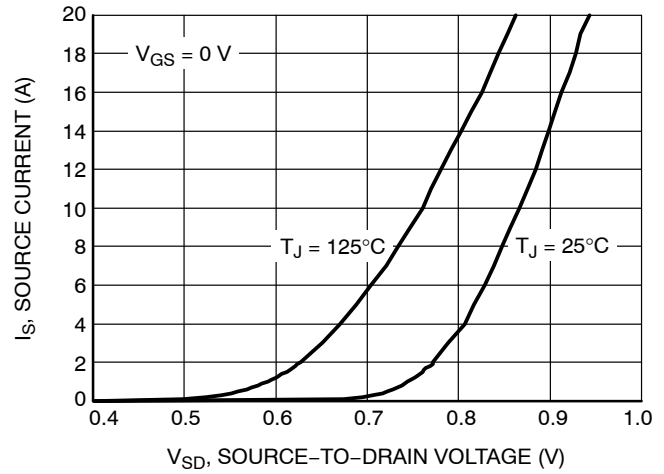


Figure 10. Diode Forward Voltage vs. Current

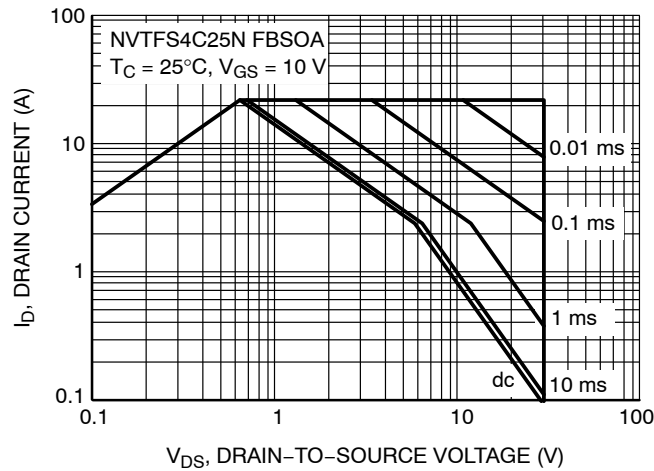


Figure 11. Maximum Rated Forward Biased Safe Operating Area

# NVTFS4C25N

## TYPICAL CHARACTERISTICS

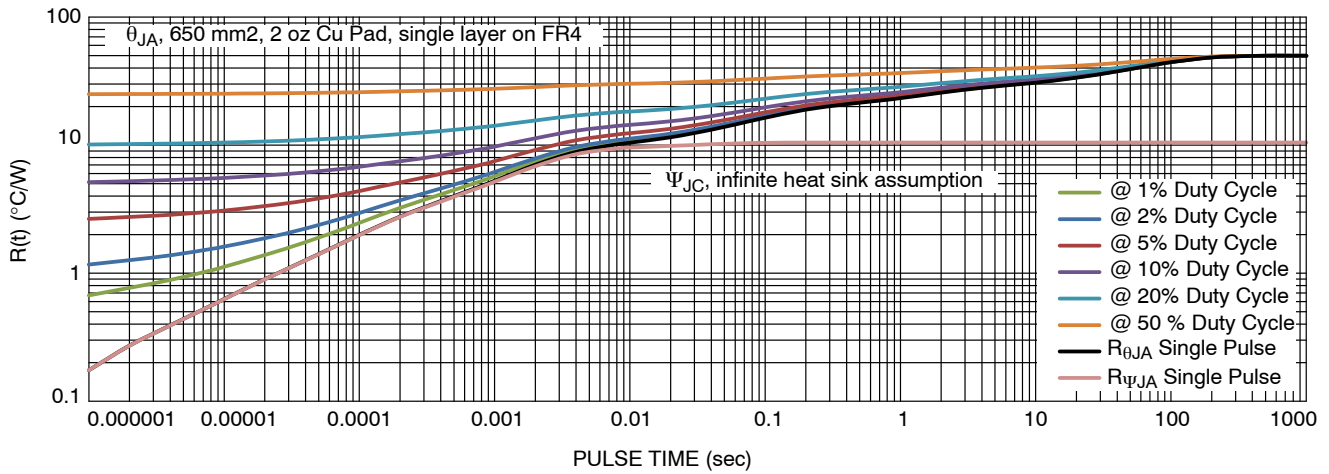


Figure 12. Thermal Response

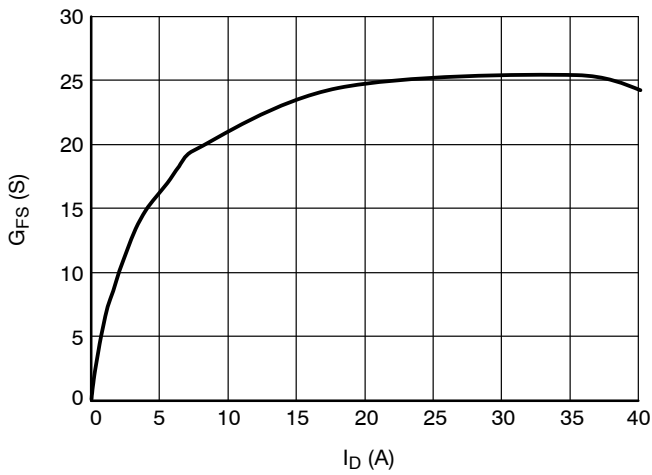


Figure 13.  $G_{FS}$  vs.  $I_D$

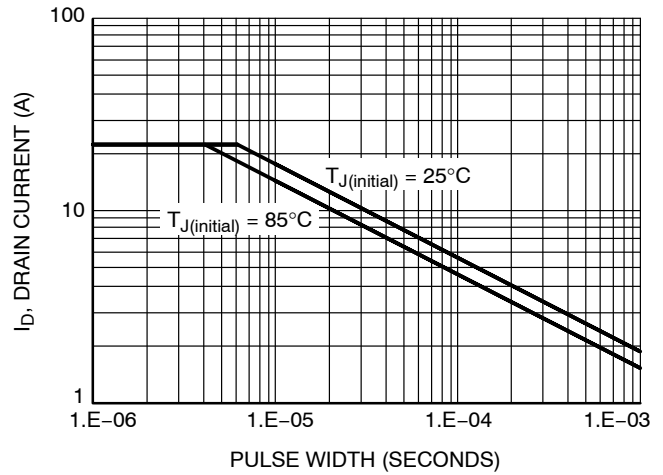


Figure 14. Avalanche Characteristics

## ORDERING INFORMATION

Device	Marking	Package	Shipping <sup>†</sup>
NVTFS4C25NTAG	4C25	WDFN8 (Pb-Free)	1500 / Tape & Reel
NVTFS4C25NWFTAG	25WF	WDFN8 (Pb-Free)	1500 / 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.

# MECHANICAL CASE OUTLINE

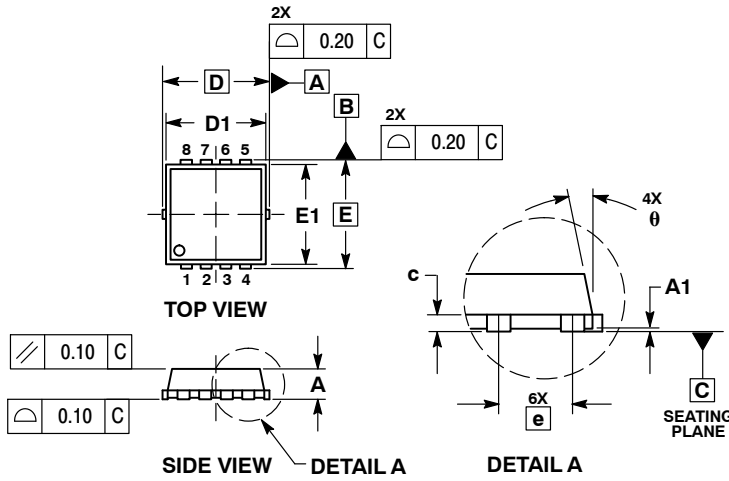
## PACKAGE DIMENSIONS



SCALE 2:1

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

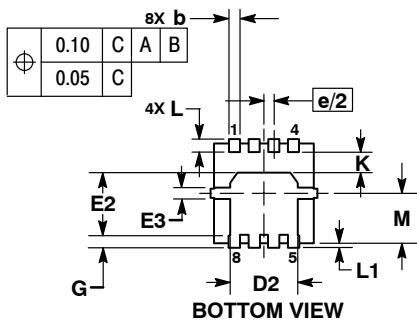
DATE 23 APR 2012



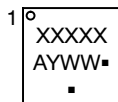
NOTES:

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

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	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
c	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
e	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°



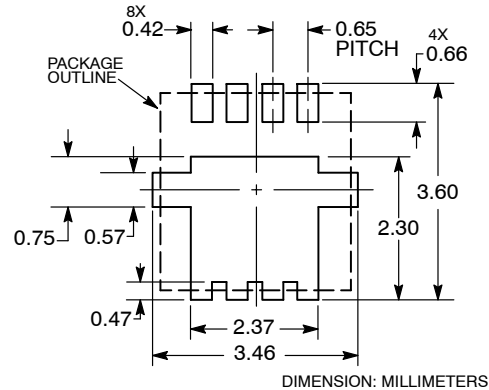
GENERIC MARKING DIAGRAM\*



- XXXXX = Specific Device Code
- A = Assembly Location
- Y = Year
- WW = Work Week
- = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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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DESCRIPTION:	WDFN8 3.3X3.3, 0.65P	PAGE 1 OF 1

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