

# 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)

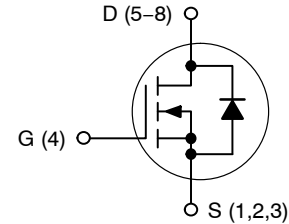
| Parameter                                                                                                                | Symbol                                         | Value                    | Unit             |
|--------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------------------------|------------------|
| Drain-to-Source Voltage                                                                                                  | $V_{DS}$                                       | 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     |
|                                                                                                                          |                                                | $T_A = 85^\circ\text{C}$ |                  |
| Power Dissipation $R_{\theta JA}$ (Notes 1, 3, 5)                                                                        | Steady State                                   | $T_A = 25^\circ\text{C}$ | $P_D$ 3.0 W      |
|                                                                                                                          |                                                | $T_A = 85^\circ\text{C}$ |                  |
| Continuous Drain Current $R_{\theta JC}$ (Notes 1, 2, 4, 5)                                                              | Steady State                                   | $T_C = 25^\circ\text{C}$ | $I_D$ 22.1 A     |
|                                                                                                                          |                                                | $T_C = 85^\circ\text{C}$ |                  |
| Power Dissipation $R_{\theta JC}$ (Notes 1, 2, 4, 5)                                                                     | Steady State                                   | $T_C = 25^\circ\text{C}$ | $P_D$ 14.3 W     |
|                                                                                                                          |                                                | $T_C = 85^\circ\text{C}$ |                  |
| 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 ( $T_J = 25^\circ\text{C}, I_L = 6.7 \text{ A}_{pk}, L = 0.5 \text{ mH}$ ) | $E_{AS}$                                       | 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.

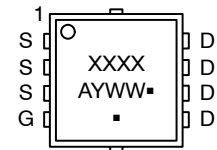
1. The entire application environment impacts the thermal resistance values shown; they are not constants and are valid for the specific conditions noted.
2. Psi ( $\psi$ ) is used as required per JESD51-12 for packages in which substantially less than 100% of the heat flows to a single case surface.
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.

| $V_{(BR)DSS}$ | $R_{DS(on)} \text{ MAX}$ | $I_D \text{ MAX}$ |
|---------------|--------------------------|-------------------|
| 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 NVTFS4C25N

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    |      |

6. The entire application environment impacts the thermal resistance values shown; they are not constants and are valid for the specific conditions noted.

7. 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.

8. Surface-mounted on FR4 board using 650 mm<sup>2</sup>, 2 oz. Cu Pad.

9. 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 |
|-----------|--------|----------------|-----|-----|-----|------|
|-----------|--------|----------------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                                           |                   |                                                     |                           |      |           |               |
|-----------------------------------------------------------|-------------------|-----------------------------------------------------|---------------------------|------|-----------|---------------|
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | 30                        |      |           | V             |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ |                                                     |                           | 15.3 |           | mV/°C         |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = 24\text{ V}$         | $T_J = 25^\circ\text{C}$  |      | 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            | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$ | 1.3 |      | 2.2  | V          |
| Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ |                                                 |     | -4.5 |      | mV/°C      |
| Drain-to-Source On Resistance     | $R_{DS(on)}$     | $V_{GS} = 10\text{ V}, I_D = 10\text{ A}$       |     | 13   | 17   | m $\Omega$ |
|                                   |                  | $V_{GS} = 4.5\text{ V}, I_D = 9\text{ A}$       |     | 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  | $t_{d(ON)}$  | $V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 10\text{ A}, R_G = 3.0\text{ }\Omega$ |  | 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  | $t_{d(ON)}$  | $V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}, I_D = 15\text{ A}, R_G = 3.0\text{ }\Omega$  |  | 4.0 |  | ns |
| Rise Time           | $t_r$        |                                                                                           |  | 25  |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |                                                                                           |  | 13  |  |    |
| Fall Time           | $t_f$        |                                                                                           |  | 2.0 |  |    |

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

11. 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                     | $V_{SD}$ | $V_{GS} = 0\text{ V},$<br>$I_S = 10\text{ A}$                                     |     | 0.87 | 1.2 | V    |
|                                           |          | $T_J = 125^\circ\text{C}$                                                         |     | 0.75 |     |      |
| Reverse Recovery Time                     | $t_{RR}$ | $V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s},$<br>$I_S = 30\text{ A}$ |     | 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  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .

11. Switching characteristics are independent of operating junction temperatures.

TYPICAL CHARACTERISTICS

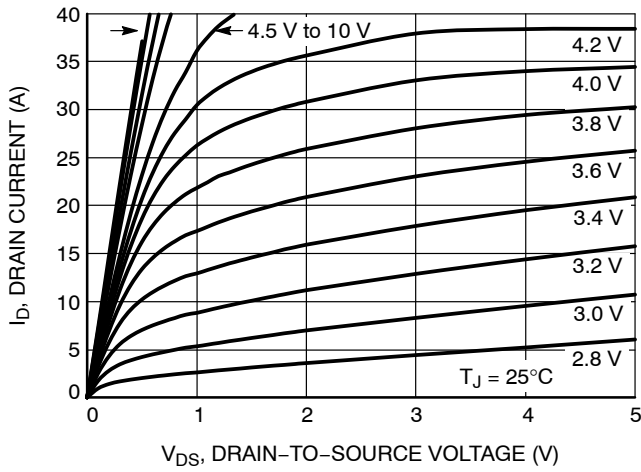


Figure 1. On-Region Characteristics

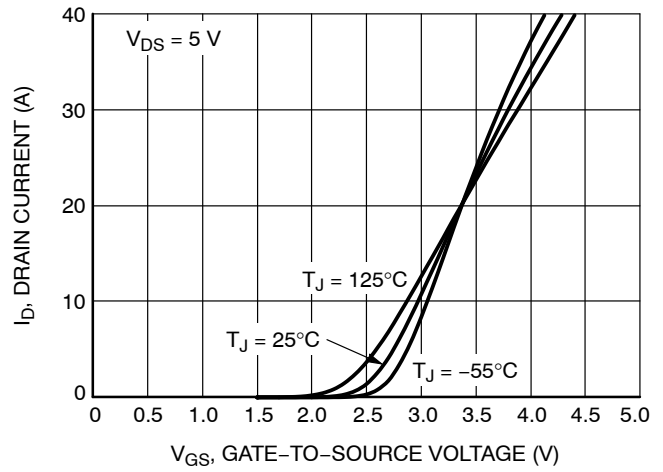


Figure 2. Transfer Characteristics

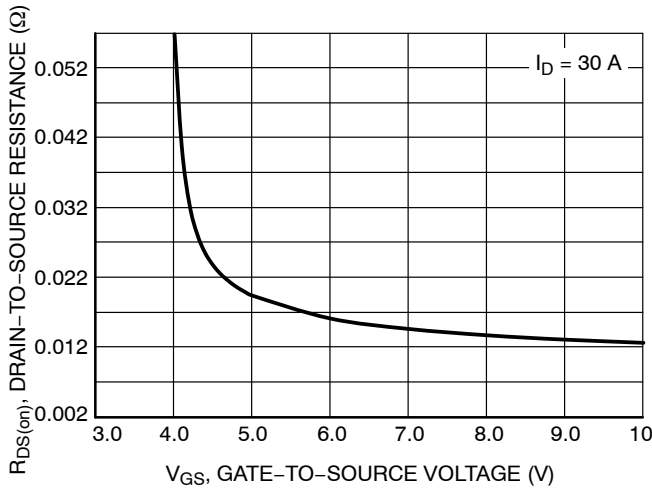


Figure 3. On-Resistance vs.  $V_{GS}$

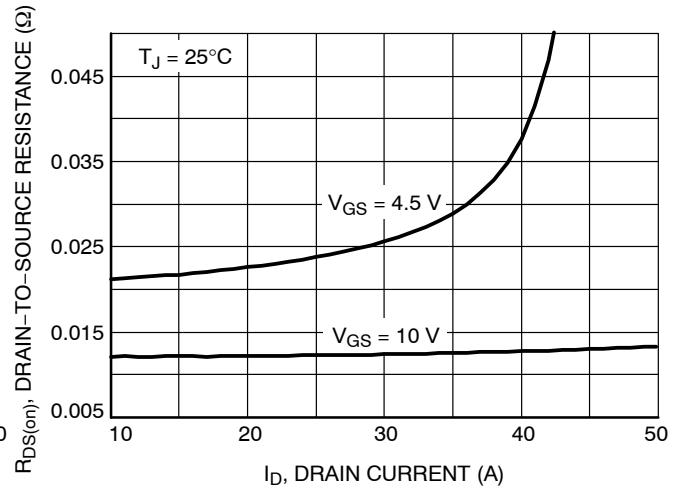


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

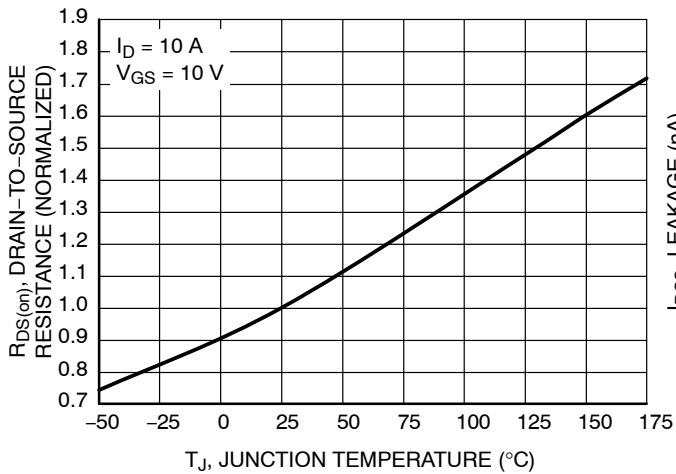


Figure 5. On-Resistance Variation with Temperature

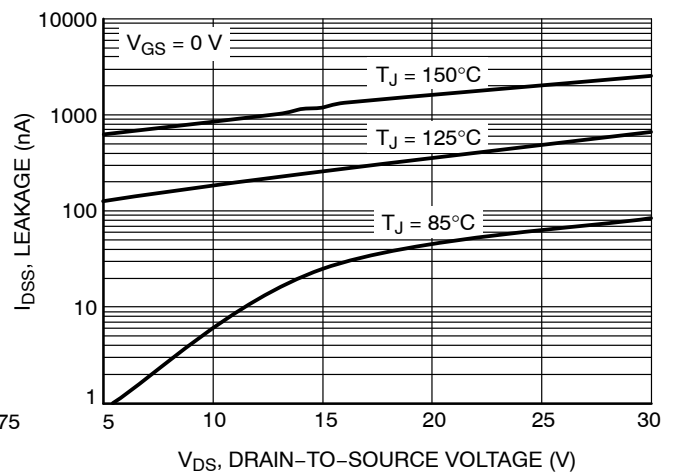


Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NVTFS4C25N

## TYPICAL CHARACTERISTICS

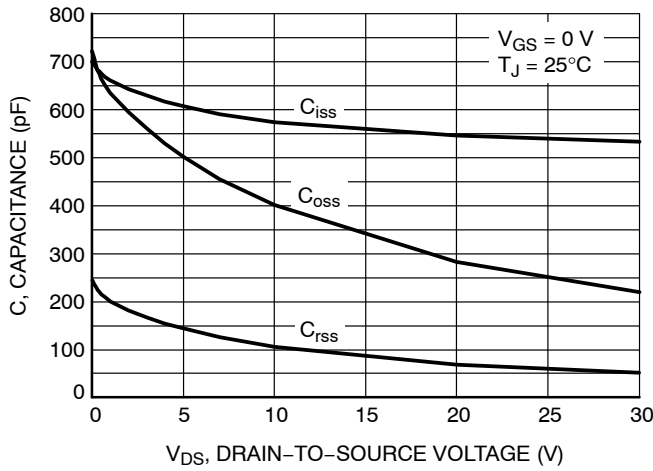


Figure 7. Capacitance Variation

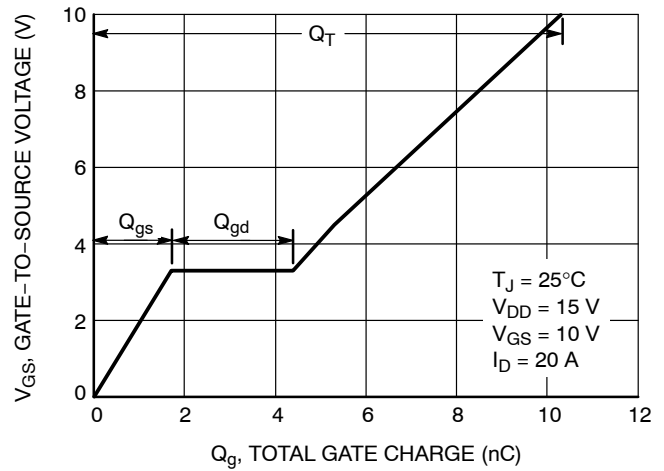


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

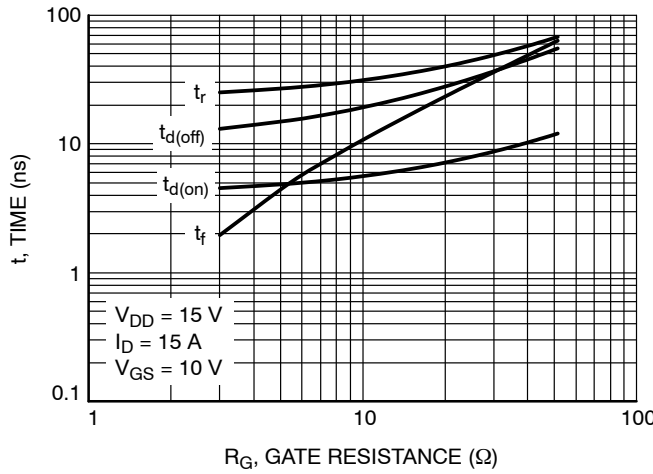


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

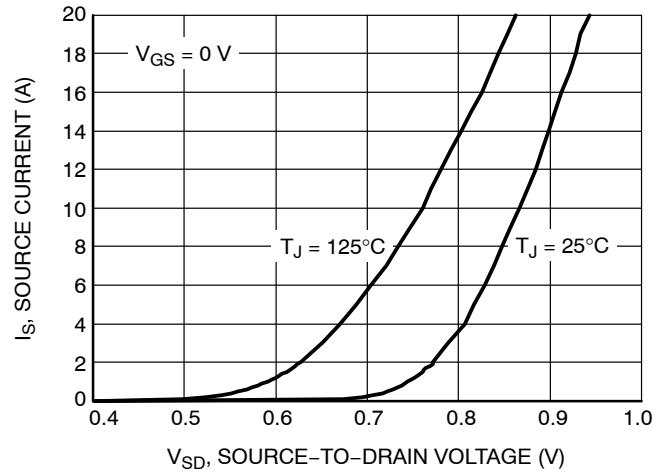


Figure 10. Diode Forward Voltage vs. Current

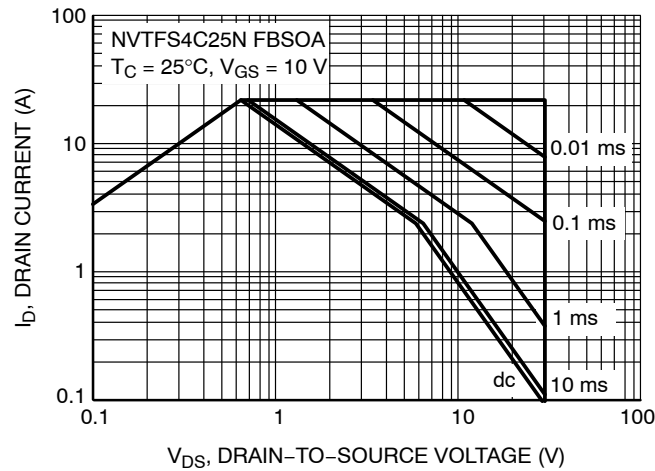


Figure 11. Maximum Rated Forward Biased Safe Operating Area

# NVTFS4C25N

## TYPICAL CHARACTERISTICS

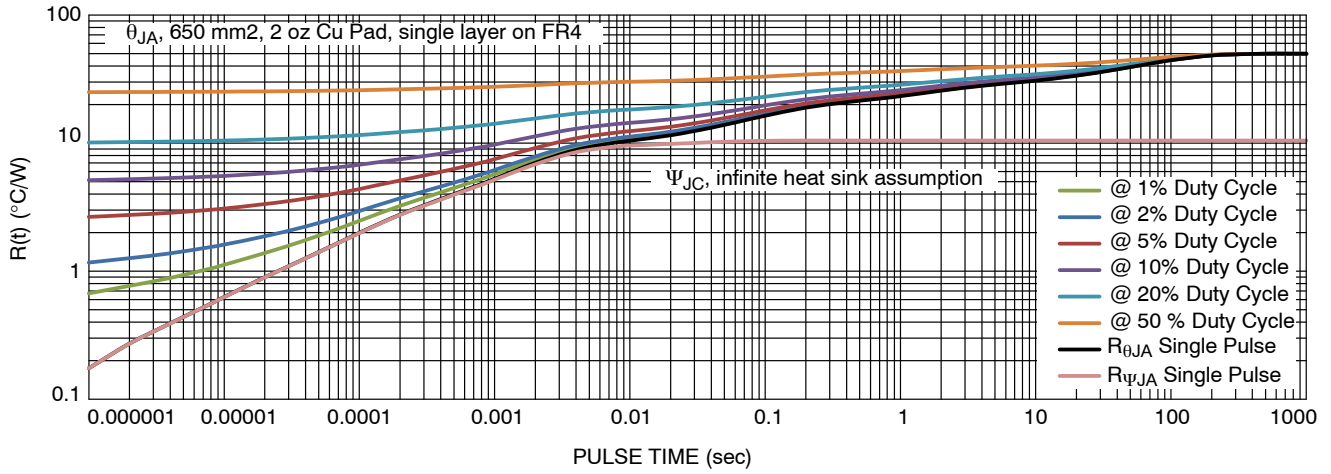


Figure 12. Thermal Response

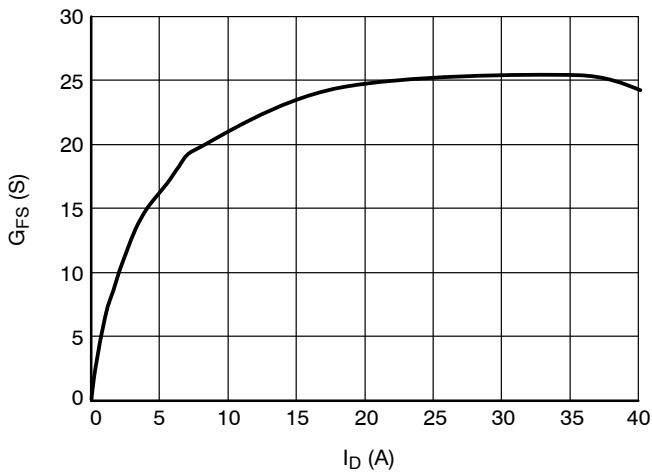


Figure 13.  $G_{FS}$  vs.  $I_D$

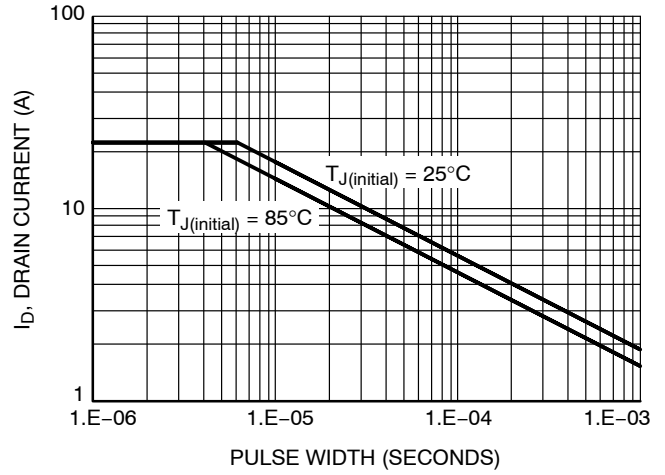


Figure 14. Avalanche Characteristics

## ORDERING INFORMATION

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

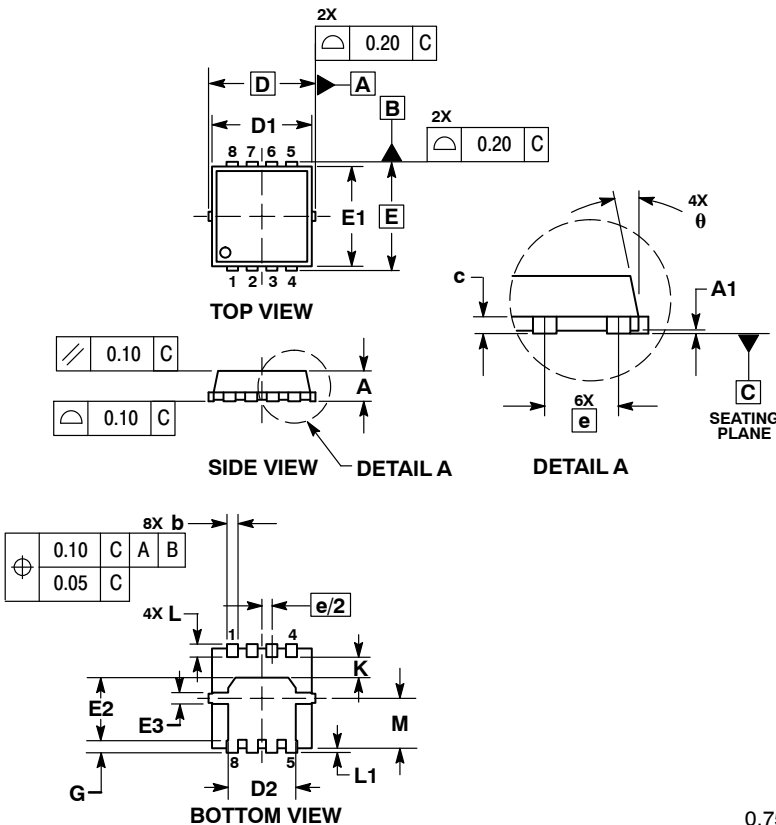
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



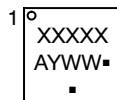
SCALE 2:1

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

DATE 23 APR 2012



GENERIC  
MARKING DIAGRAM\*



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

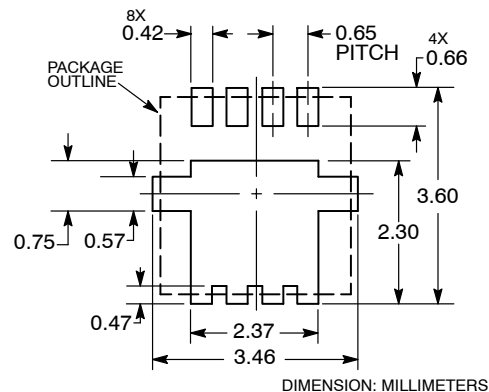
\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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 |
| theta | 0 °         | ---  | 12 ° | 0 °       | ---   | 12 °  |

SOLDERING FOOTPRINT\*



DIMENSION: MILLIMETERS

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

|                  |                      |                                                                                                                                                                                  |
|------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DOCUMENT NUMBER: | 98AON30561E          | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| DESCRIPTION:     | WDFN8 3.3X3.3, 0.65P | PAGE 1 OF 1                                                                                                                                                                      |

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

**onsemi**, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## ADDITIONAL INFORMATION

### TECHNICAL PUBLICATIONS:

Technical Library: [www.onsemi.com/design/resources/technical-documentation](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

### ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)

For additional information, please contact your local Sales Representative at  
[www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)