

# MOSFET – Power, Single P-Channel

**-60 V, -14 A, 52 mΩ**

## NVTFS5116PL

### Features

- Small Footprint (3.3 x 3.3 mm) for Compact Design
- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low Capacitance to Minimize Driver Losses
- NVTFS5116PLWF – Wettable Flanks Product
- AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant

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

| Parameter                                                                                                                                                                                                   |                                                            |                                | Symbol            | Value       | Unit               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|--------------------------------|-------------------|-------------|--------------------|
| Drain-to-Source Voltage                                                                                                                                                                                     |                                                            |                                | $V_{DSS}$         | -60         | V                  |
| Gate-to-Source Voltage                                                                                                                                                                                      |                                                            |                                | $V_{GS}$          | $\pm 20$    | V                  |
| Continuous Drain Current $R_{\Psi J-mb}$ (Notes 1, 2, 3, 4)                                                                                                                                                 | Steady State                                               | $T_{mb} = 25^{\circ}\text{C}$  | $I_D$             | -14         | A                  |
|                                                                                                                                                                                                             |                                                            | $T_{mb} = 100^{\circ}\text{C}$ |                   | -10         |                    |
| Power Dissipation $R_{\Psi J-mb}$ (Notes 1, 2, 3)                                                                                                                                                           | Steady State                                               | $T_{mb} = 25^{\circ}\text{C}$  | $P_D$             | 21          | W                  |
|                                                                                                                                                                                                             |                                                            | $T_{mb} = 100^{\circ}\text{C}$ |                   | 10          |                    |
| Continuous Drain Current $R_{\theta JA}$ (Notes 1 & 3, 4)                                                                                                                                                   | Steady State                                               | $T_A = 25^{\circ}\text{C}$     | $I_D$             | -6          | A                  |
|                                                                                                                                                                                                             |                                                            | $T_A = 100^{\circ}\text{C}$    |                   | -4          |                    |
| Power Dissipation $R_{\theta JA}$ (Notes 1, 3)                                                                                                                                                              | Steady State                                               | $T_A = 25^{\circ}\text{C}$     | $P_D$             | 3.2         | W                  |
|                                                                                                                                                                                                             |                                                            | $T_A = 100^{\circ}\text{C}$    |                   | 1.6         |                    |
| Pulsed Drain Current                                                                                                                                                                                        | $T_A = 25^{\circ}\text{C}$ , $t_p = 10\text{ }\mu\text{s}$ |                                | $I_{DM}$          | -126        | A                  |
| Operating Junction and Storage Temperature                                                                                                                                                                  |                                                            |                                | $T_J$ , $T_{stg}$ | -55 to +175 | $^{\circ}\text{C}$ |
| Source Current (Body Diode)                                                                                                                                                                                 |                                                            |                                | $I_S$             | -17         | A                  |
| Single Pulse Drain-to-Source Avalanche Energy ( $T_J = 25^{\circ}\text{C}$ , $V_{DD} = 50\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_{L(pk)} = 30\text{ A}$ , $L = 0.1\text{ mH}$ , $R_G = 25\text{ }\Omega$ ) |                                                            |                                | $E_{AS}$          | 45          | 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.

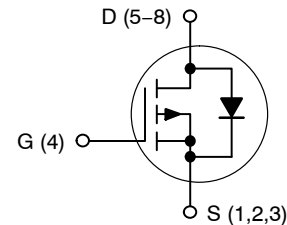
### THERMAL RESISTANCE MAXIMUM RATINGS (Note 1)

| Parameter                                                      | Symbol          | Value | Unit                      |
|----------------------------------------------------------------|-----------------|-------|---------------------------|
| Junction-to-Mounting Board (top) – Steady State (Note 2 and 3) | $R_{\Psi J-mb}$ | 7.2   | $^\circ\text{C}/\text{W}$ |
| Junction-to-Ambient – Steady State (Note 3)                    | $R_{\theta JA}$ | 47    |                           |

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. Psi ( $\Psi$ ) is used as required per JESD51-12 for packages in which substantially less than 100% of the heat flows to single case surface.
3. Surface-mounted on FR4 board using a 650 mm<sup>2</sup>, 2 oz. Cu pad.
4. Continuous DC current rating. Maximum current for pulses as long as 1 second is higher but is dependent on pulse duration and duty cycle.

| $V_{(BR)DSS}$ | $R_{DS(on)} \text{ MAX}$ | $I_D \text{ MAX}$ |
|---------------|--------------------------|-------------------|
| -60 V         | 52 mΩ @ -10 V            | -14 A             |
|               | 72 mΩ @ -4.5 V           |                   |

### P-Channel MOSFET

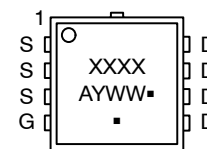


WDFN8 3.3x3.3, 0.65P  
CASE 511AB



WDFN8 3.3x3.3, 0.65P (Full-Cut μ8FL WF)  
CASE 515AN

### MARKING DIAGRAM



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

(Note: Microdot may be in either location)

### ORDERING INFORMATION

See detailed ordering, marking and shipping information in the package dimensions section on page 5 of this data sheet.

# NVTF5116PL

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

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|-----------|--------|----------------|-----|-----|-----|------|
|-----------|--------|----------------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                   |                      |                                                  |                        |  |      |    |
|-----------------------------------|----------------------|--------------------------------------------------|------------------------|--|------|----|
| Drain-to-Source Breakdown Voltage | V <sub>(BR)DSS</sub> | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA   | -60                    |  |      | V  |
| Zero Gate Voltage Drain Current   | I <sub>DSS</sub>     | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = 60 V | T <sub>J</sub> = 25°C  |  | -1.0 | μA |
|                                   |                      |                                                  | T <sub>J</sub> = 125°C |  | -10  |    |
| 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 5)

|                               |                     |                                                              |    |    |    |    |
|-------------------------------|---------------------|--------------------------------------------------------------|----|----|----|----|
| Gate Threshold Voltage        | V <sub>GS(TH)</sub> | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = -250 μA | -1 |    | -3 | V  |
| Drain-to-Source On Resistance | R <sub>DS(on)</sub> | V <sub>GS</sub> = -10 V, I <sub>D</sub> = -7 A               |    | 37 | 52 | mΩ |
|                               |                     | V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -7 A              |    | 51 | 72 |    |
| Forward Transconductance      | g <sub>FS</sub>     | V <sub>DS</sub> = 15 V, I <sub>D</sub> = -5 A                |    | 11 |    | S  |

### CHARGES AND CAPACITANCES

|                              |                     |                                                                             |  |      |  |    |
|------------------------------|---------------------|-----------------------------------------------------------------------------|--|------|--|----|
| Input Capacitance            | C <sub>iss</sub>    | V <sub>GS</sub> = 0 V, f = 1.0 MHz,<br>V <sub>DS</sub> = -25 V              |  | 1258 |  | pF |
| Output Capacitance           | C <sub>oss</sub>    |                                                                             |  | 127  |  |    |
| Reverse Transfer Capacitance | C <sub>rss</sub>    |                                                                             |  | 84   |  |    |
| Total Gate Charge            | Q <sub>G(TOT)</sub> | V <sub>GS</sub> = -4.5 V, V <sub>DS</sub> = -48 V,<br>I <sub>D</sub> = -7 A |  | 14   |  | nC |
| Threshold Gate Charge        | Q <sub>G(TH)</sub>  |                                                                             |  | 1    |  |    |
| Gate-to-Source Charge        | Q <sub>GS</sub>     |                                                                             |  | 4    |  |    |
| Gate-to-Drain Charge         | Q <sub>GD</sub>     |                                                                             |  | 8    |  |    |
| Total Gate Charge            | Q <sub>G(TOT)</sub> | V <sub>GS</sub> = -10 V, V <sub>DS</sub> = -48 V,<br>I <sub>D</sub> = -7 A  |  | 25   |  | nC |

### SWITCHING CHARACTERISTICS (Note 6)

|                     |                     |                                                                             |  |    |  |    |
|---------------------|---------------------|-----------------------------------------------------------------------------|--|----|--|----|
| Turn-On Delay Time  | t <sub>d(on)</sub>  | V <sub>GS</sub> = -4.5 V, V <sub>DS</sub> = -48 V,<br>I <sub>D</sub> = -7 A |  | 14 |  | ns |
| Rise Time           | t <sub>r</sub>      |                                                                             |  | 68 |  |    |
| Turn-Off Delay Time | t <sub>d(off)</sub> |                                                                             |  | 24 |  |    |
| Fall Time           | t <sub>f</sub>      |                                                                             |  | 36 |  |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                         |                 |                                                                                 |                        |  |       |       |    |
|-------------------------|-----------------|---------------------------------------------------------------------------------|------------------------|--|-------|-------|----|
| Forward Diode Voltage   | V <sub>SD</sub> | V <sub>GS</sub> = 0 V,<br>I <sub>S</sub> = -7 A                                 | T <sub>J</sub> = 25°C  |  | -0.79 | -1.20 | V  |
|                         |                 |                                                                                 | T <sub>J</sub> = 125°C |  | -0.64 |       |    |
| Reverse Recovery Time   | t <sub>RR</sub> | V <sub>GS</sub> = 0 V, dI <sub>S</sub> /dt = 100 A/μs,<br>I <sub>S</sub> = -7 A |                        |  | 21    |       | ns |
| Charge Time             | t <sub>a</sub>  |                                                                                 |                        |  | 16    |       |    |
| Discharge Time          | t <sub>b</sub>  |                                                                                 |                        |  | 5     |       |    |
| Reverse Recovery Charge | Q <sub>RR</sub> |                                                                                 |                        |  | 24    |       | nC |

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

6. Switching characteristics are independent of operating junction temperatures.

TYPICAL CHARACTERISTICS

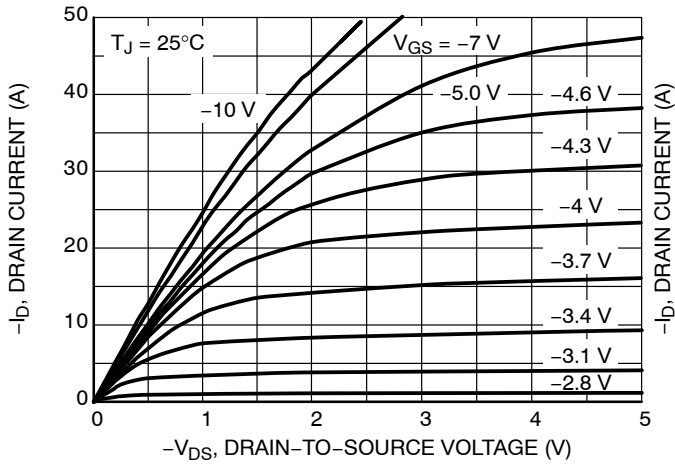


Figure 1. On-Region Characteristics

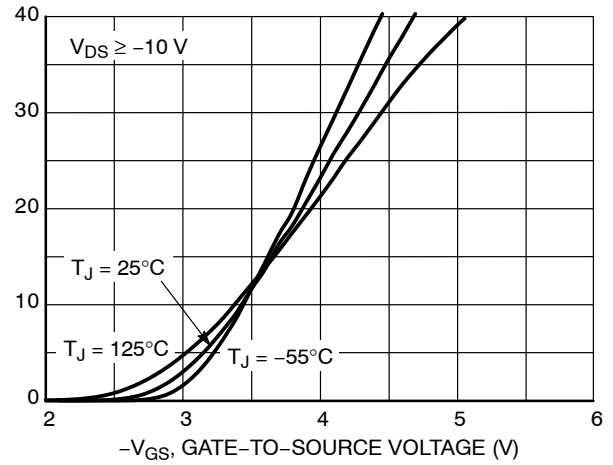


Figure 2. Transfer Characteristics

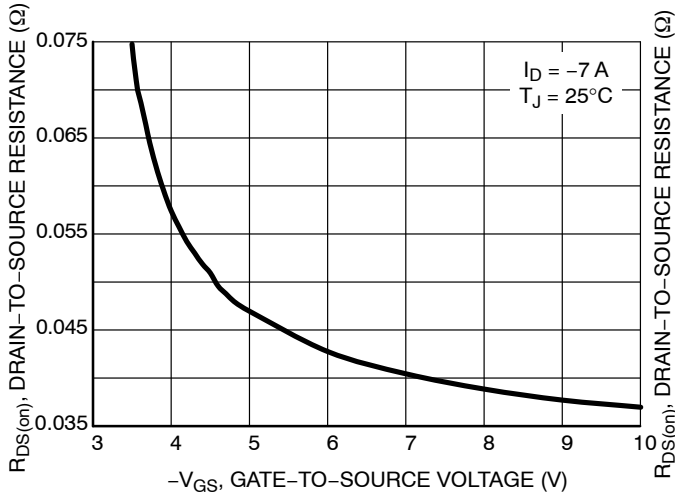


Figure 3. On-Resistance vs. Gate-to-Source Voltage

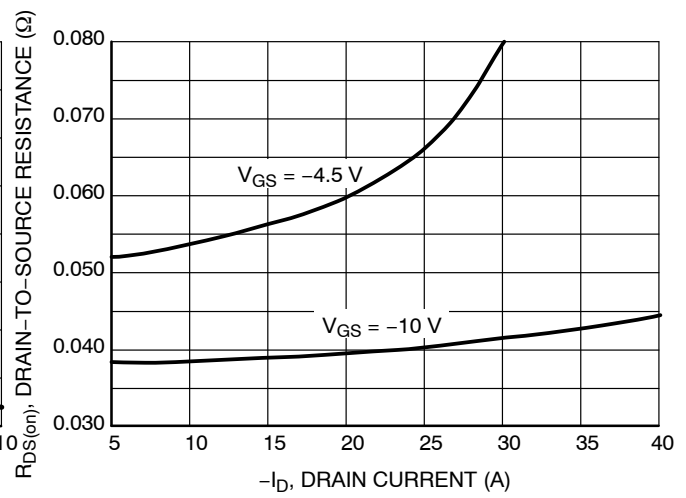


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

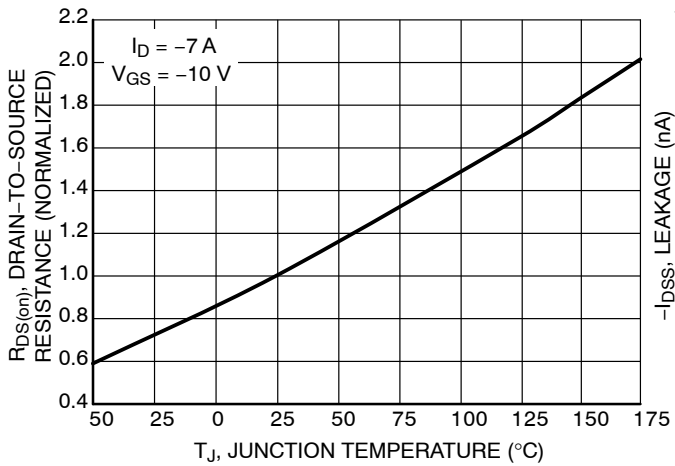


Figure 5. On-Resistance Variation with Temperature

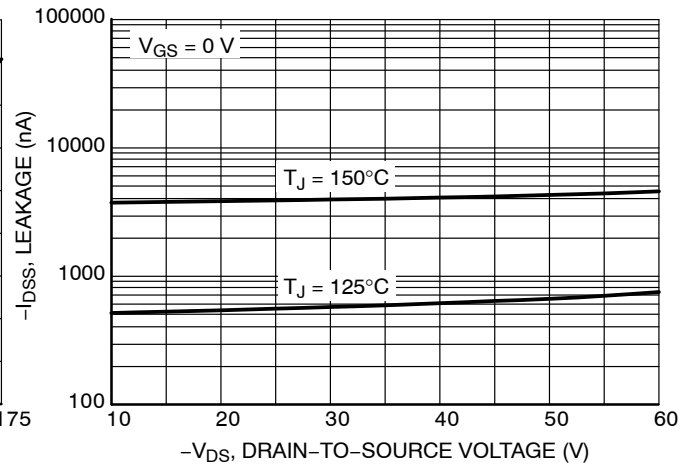
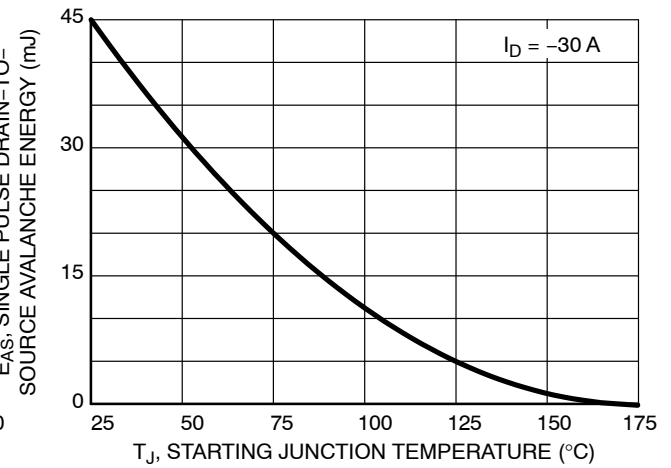
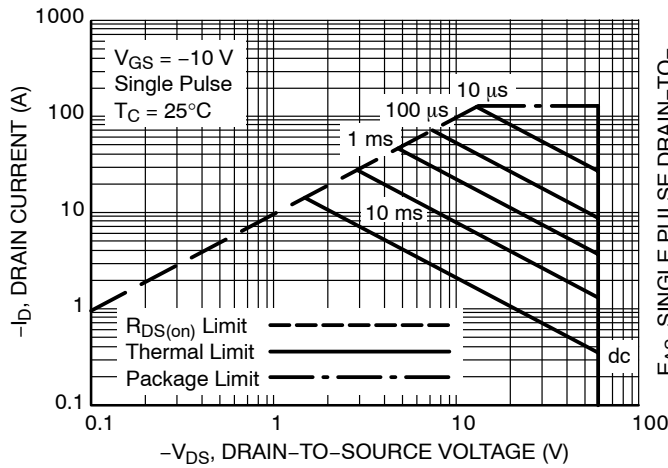
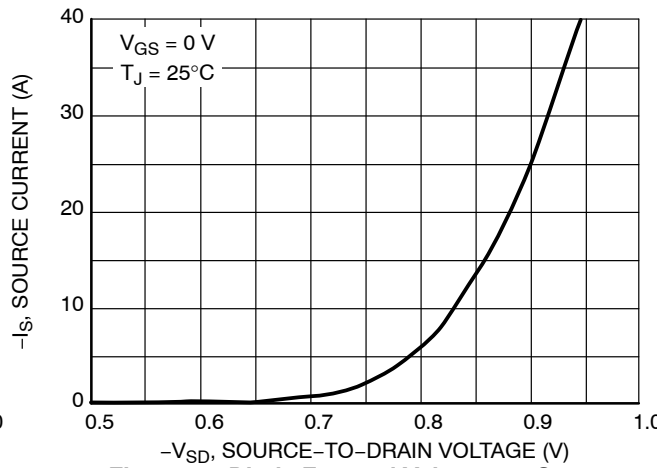
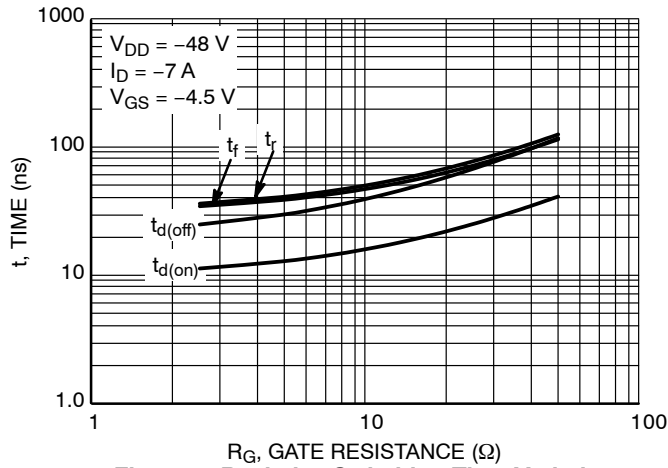
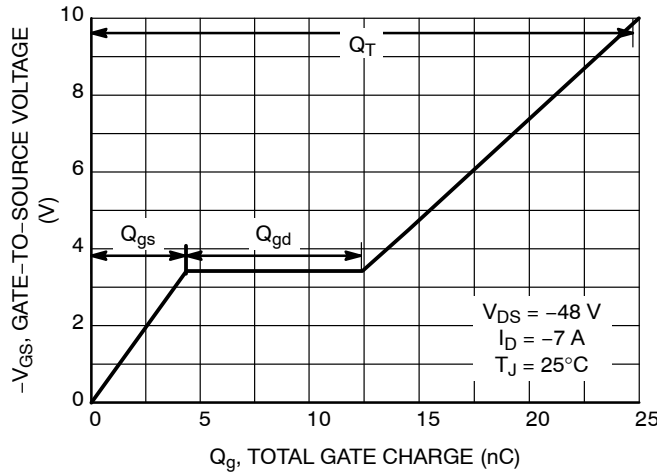
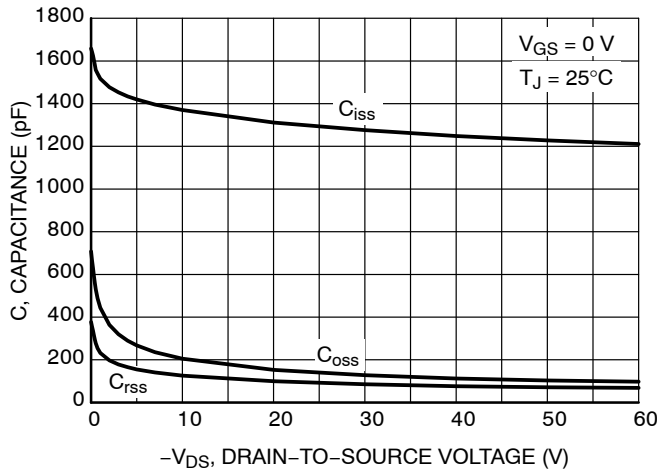


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS



# NVTFS5116PL

## TYPICAL CHARACTERISTICS

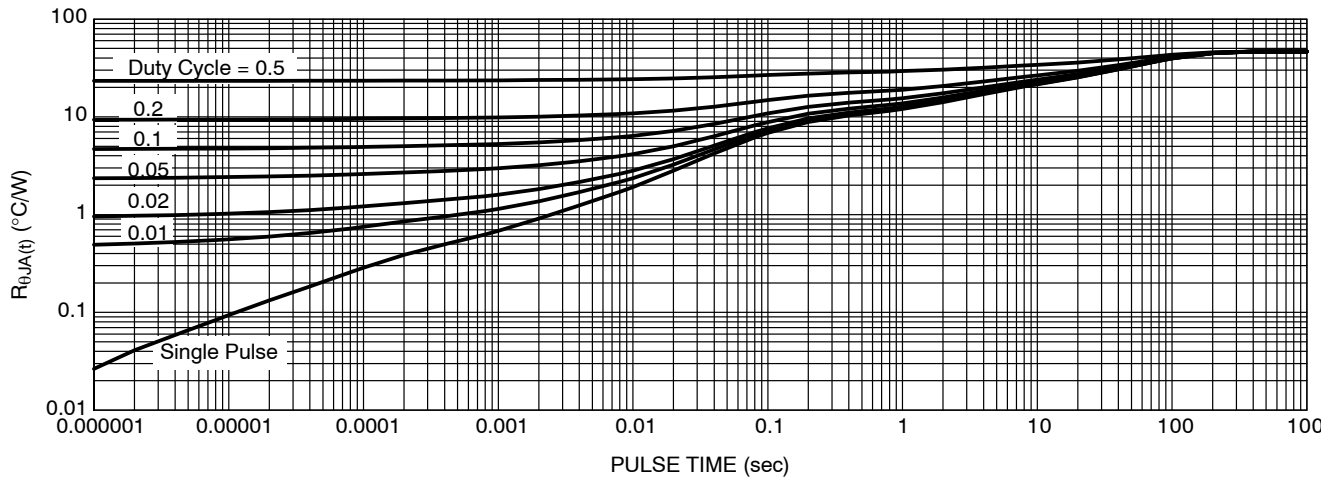


Figure 13. Thermal Response

### DEVICE ORDERING INFORMATION

| Device           | Marking | Package                                                                  | Shipping <sup>†</sup> |
|------------------|---------|--------------------------------------------------------------------------|-----------------------|
| NVTFS5116PLTAG   | 5116    | WDFN8 3.3x3.3, 0.65P (Pb-Free)                                           | 1500 / Tape & Reel    |
| NVTFS5116PLWFTAG | 16LW    | WDFN8 3.3x3.3, 0.65P (Pb-Free)                                           | 1500 / Tape & Reel    |
| NVTFS5116PLTWG   | 5116    | WDFN8 3.3x3.3, 0.65P (Pb-Free)                                           | 5000 / Tape & Reel    |
| NVTFS5116PLWFTWG | 16LW    | WDFNW8 3.3x3.3, 0.65P (Full-Cut $\mu$ 8FL WF) (Pb-Free, Wettable Flanks) | 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.

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



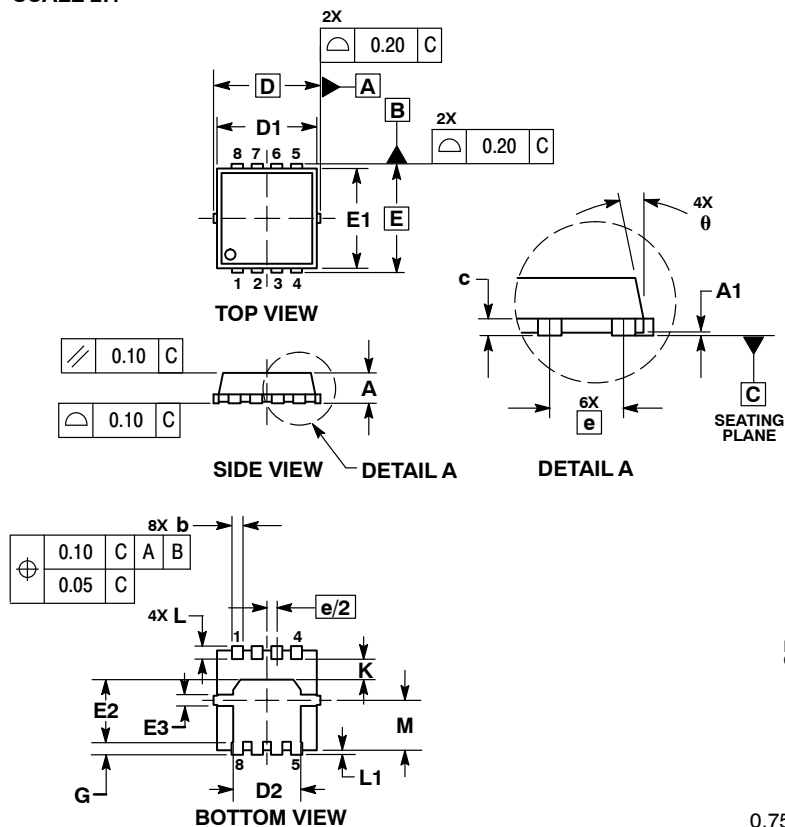
SCALE 2:1

### WDFN8 3.3x3.3, 0.65P

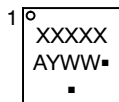
#### CASE 511AB

#### ISSUE D

DATE 23 APR 2012



### GENERIC MARKING DIAGRAM\*



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

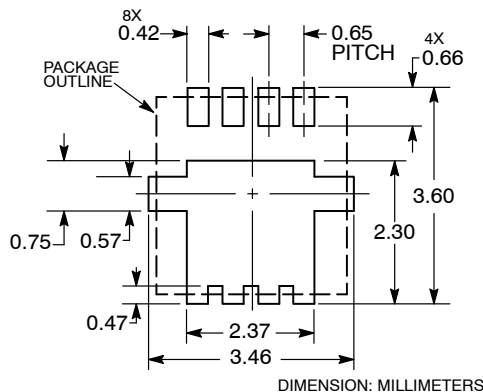
\*This information is generic. Please refer to device data sheet for actual part marking.  
 Pb-Free indicator, "G" or microdot "■", may or may not be present.

### 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°   |

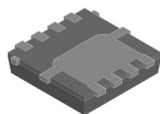
### SOLDERING FOOTPRINT\*



\*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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| <b>DESCRIPTION:</b>     | <b>WDFN8 3.3X3.3, 0.65P</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                                  |

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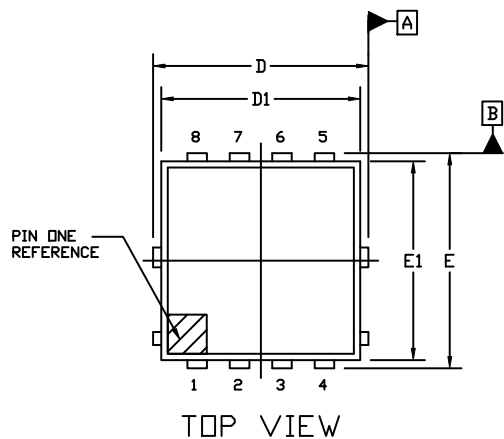


### WDFNW8 3.3x3.3, 0.65P (Full-Cut μ8FL WF)

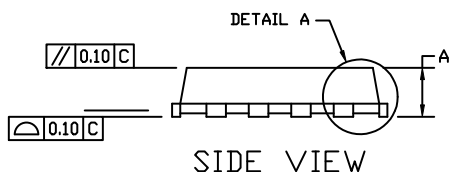
#### CASE 515AN

#### ISSUE O

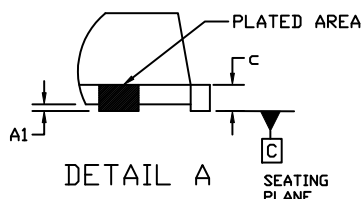
DATE 25 AUG 2020



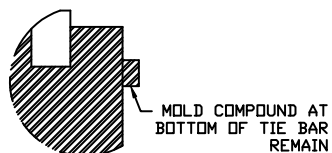
TOP VIEW



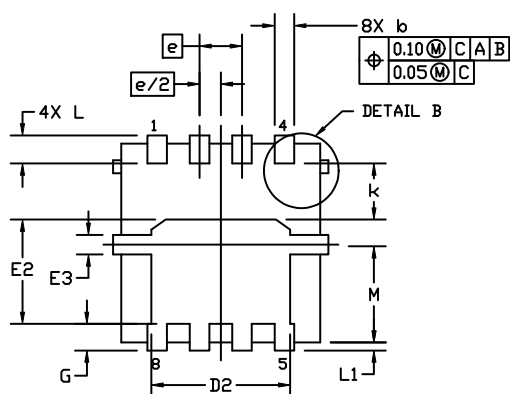
SIDE VIEW



DETAIL A



DETAIL B

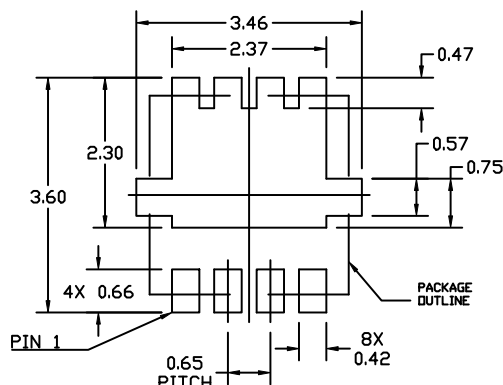


BOTTOM VIEW

#### NOTES:

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

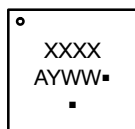
| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NDM. | MAX. |
| A   | 0.70        | 0.75 | 0.80 |
| A1  | 0.00        | ---- | 0.05 |
| b   | 0.23        | 0.30 | 0.40 |
| c   | 0.15        | 0.20 | 0.25 |
| D   | 3.05        | 3.30 | 3.55 |
| D1  | 2.95        | 3.05 | 3.15 |
| D2  | 1.98        | 2.11 | 2.24 |
| E   | 3.05        | 3.30 | 3.55 |
| E1  | 2.95        | 3.05 | 3.15 |
| E2  | 1.47        | 1.60 | 1.73 |
| E3  | 0.23        | 0.30 | 0.40 |
| e   | 0.65 BSC    |      |      |
| G   | 0.30        | 0.41 | 0.51 |
| K   | 0.65        | 0.80 | 0.95 |
| L   | 0.30        | 0.43 | 0.59 |
| L1  | 0.06        | 0.13 | 0.20 |
| M   | 1.40        | 1.50 | 1.60 |



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, SOLDERRM/D.

#### GENERIC MARKING DIAGRAM\*



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

(Note: Microdot may be in either location)

\*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.

|                  |                                          |                                                                                                                                                                                  |
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| DESCRIPTION:     | WDFNW8 3.3x3.3, 0.65P (Full-Cut μ8FL WF) | PAGE 1 OF 1                                                                                                                                                                      |

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