

# NTTFS5116PL

## MOSFET – Power -60 V, -20 A, 52 mΩ

### Features

- Low  $R_{DS(on)}$
- Fast Switching
- These Devices are Pb-Free and are RoHS Compliant

### Applications

- Load Switches
- DC Motor Control
- DC-DC Conversion

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

| Parameter                                                         |                         |                             | Symbol               | Value       | Unit               |
|-------------------------------------------------------------------|-------------------------|-----------------------------|----------------------|-------------|--------------------|
| Drain-to-Source Voltage                                           |                         |                             | $V_{DSS}$            | -60         | V                  |
| Gate-to-Source Voltage                                            |                         |                             | $V_{GS}$             | $\pm 20$    | V                  |
| Continuous Drain Current $R_{\theta JA}$ (Note 1)                 | Steady State            | $T_A = 25^{\circ}\text{C}$  | $I_D$                | -5.7        | A                  |
|                                                                   |                         | $T_A = 100^{\circ}\text{C}$ |                      | -4.0        |                    |
| Power Dissipation $R_{\theta JA}$ (Note 1)                        |                         | $T_A = 25^{\circ}\text{C}$  | $P_D$                | 3.2         | W                  |
|                                                                   |                         | $T_A = 100^{\circ}\text{C}$ |                      | 1.6         |                    |
| Continuous Drain Current $R_{\theta JC}$ (Note 1)                 |                         | $T_C = 25^{\circ}\text{C}$  | $I_D$                | -20         | A                  |
|                                                                   |                         | $T_C = 100^{\circ}\text{C}$ |                      | -14         |                    |
| Power Dissipation $R_{\theta JC}$ (Note 1)                        |                         | $T_C = 25^{\circ}\text{C}$  | $P_D$                | 40          | W                  |
|                                                                   |                         | $T_C = 100^{\circ}\text{C}$ |                      | 20          |                    |
| Pulsed Drain Current                                              | $t_p = 10\ \mu\text{s}$ | $I_{DM}$                    | -76                  | A           |                    |
| Operating Junction and Storage Temperature                        |                         |                             | $T_J$ ,<br>$T_{stg}$ | -55 to +175 | $^{\circ}\text{C}$ |
| Source Current (Body Diode)                                       |                         |                             | $I_S$                | -20         | A                  |
| Single Pulse Drain-to-Source Avalanche Energy                     | $L = 0.1\ \text{mH}$    | $E_{AS}$                    | 45                   | mJ          |                    |
|                                                                   |                         | $I_{AS}$                    | 30                   | A           |                    |
| 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 (Note 1)    | $R_{\theta JC}$ | 3.8   | $^\circ\text{C/W}$ |
| Junction-to-Ambient – Steady State (Note 1) | $R_{\theta JA}$ | 47    |                    |

1. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces).

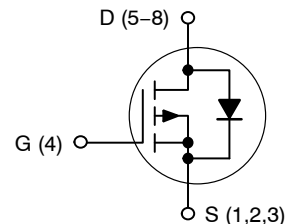


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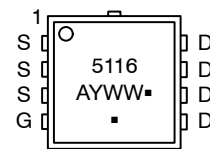
| $V_{(BR)DSS}$ | $R_{DS(on)}$ MAX | $I_D$ MAX |
|---------------|------------------|-----------|
| -60 V         | 52 mΩ @ -10 V    | -20 A     |
|               | 72 mΩ @ -4.5 V   |           |

### P-Channel MOSFET



WDFN8  
(μ8FL)  
CASE 511AB

### MARKING DIAGRAM



5116 = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device         | Package         | Shipping†        |
|----------------|-----------------|------------------|
| NTTFS5116PLTAG | WDFN8 (Pb-Free) | 1500/Tape & Reel |
| NTTFS5116PLTWG | WDFN8 (Pb-Free) | 5000/Tape & Reel |

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

# NTTFS5116PL

## 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                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$ | -60                       |      |           | V                    |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ |                                                      |                           | 69.7 |           | mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = -60\text{ V}$         | $T_J = 25^\circ\text{C}$  |      | -1.0      | $\mu\text{A}$        |
|                                                           |                   |                                                      | $T_J = 125^\circ\text{C}$ |      | -100      |                      |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$      |                           |      | $\pm 100$ | nA                   |

### ON CHARACTERISTICS (Note 2)

|                                            |                  |                                                  |    |      |    |                      |
|--------------------------------------------|------------------|--------------------------------------------------|----|------|----|----------------------|
| Gate Threshold Voltage                     | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = -250\text{ }\mu\text{A}$ | -1 |      | -3 | V                    |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ |                                                  |    | -6.2 |    | mV/ $^\circ\text{C}$ |
| Drain-to-Source On Resistance              | $R_{DS(on)}$     | $V_{GS} = -10\text{ V}, I_D = -6\text{ A}$       |    | 37   | 52 | $\text{m}\Omega$     |
|                                            |                  | $V_{GS} = -4.5\text{ V}, I_D = -4.4\text{ A}$    |    | 51   | 72 |                      |
| Forward Transconductance                   | $g_{FS}$         | $V_{DS} = -15\text{ V}, I_D = -6\text{ A}$       |    | 11   |    | S                    |

### CHARGES, CAPACITANCES AND GATE RESISTANCE

|                              |              |                                                                    |  |      |  |          |
|------------------------------|--------------|--------------------------------------------------------------------|--|------|--|----------|
| Input Capacitance            | $C_{iss}$    | $V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = -30\text{ V}$   |  | 1258 |  | pF       |
| Output Capacitance           | $C_{oss}$    |                                                                    |  | 127  |  |          |
| Reverse Transfer Capacitance | $C_{rss}$    |                                                                    |  | 84   |  |          |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = -10\text{ V}, V_{DS} = -48\text{ V}, I_D = -5\text{ A}$  |  | 25   |  | nC       |
|                              |              | $V_{GS} = -4.5\text{ V}, V_{DS} = -48\text{ V}, I_D = -5\text{ A}$ |  | 14   |  |          |
| Threshold Gate Charge        | $Q_{G(TH)}$  | $V_{GS} = -4.5\text{ V}, V_{DS} = -48\text{ V}, I_D = -5\text{ A}$ |  | 1    |  | nC       |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                    |  | 4    |  |          |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                    |  | 7    |  |          |
| Plateau Voltage              | $V_{GP}$     |                                                                    |  | 3.1  |  | V        |
| Gate Resistance              | $R_G$        |                                                                    |  | 5.3  |  | $\Omega$ |

### SWITCHING CHARACTERISTICS (Note 3)

|                     |              |                                                                                           |  |    |  |    |
|---------------------|--------------|-------------------------------------------------------------------------------------------|--|----|--|----|
| Turn-On Delay Time  | $t_{d(on)}$  | $V_{GS} = -4.5\text{ V}, V_{DS} = -48\text{ V}, I_D = -5\text{ A}, R_G = 6\text{ }\Omega$ |  | 15 |  | ns |
| Rise Time           | $t_r$        |                                                                                           |  | 58 |  |    |
| Turn-Off Delay Time | $t_{d(off)}$ |                                                                                           |  | 30 |  |    |
| Fall Time           | $t_f$        |                                                                                           |  | 37 |  |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                         |          |                                                                               |                           |    |       |      |    |
|-------------------------|----------|-------------------------------------------------------------------------------|---------------------------|----|-------|------|----|
| Forward Diode Voltage   | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = -5\text{ A}$                                      | $T_J = 25^\circ\text{C}$  |    | -0.79 | -1.2 | V  |
|                         |          |                                                                               | $T_J = 125^\circ\text{C}$ |    | -0.64 |      |    |
| Reverse Recovery Time   | $t_{RR}$ | $V_{GS} = 0\text{ V}, dI_S/dt = -100\text{ A}/\mu\text{s}, I_S = -5\text{ A}$ |                           | 20 |       |      | ns |
| Charge Time             | $t_a$    |                                                                               |                           | 15 |       |      |    |
| Discharge Time          | $t_b$    |                                                                               |                           | 5  |       |      |    |
| Reverse Recovery Charge | $Q_{RR}$ |                                                                               |                           | 19 |       |      | nC |

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

3. Switching characteristics are independent of operating junction temperatures.

TYPICAL CHARACTERISTICS

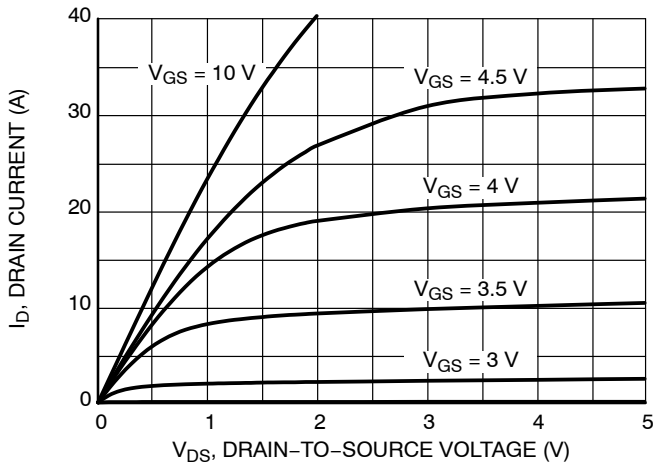


Figure 1. On-Region Characteristics

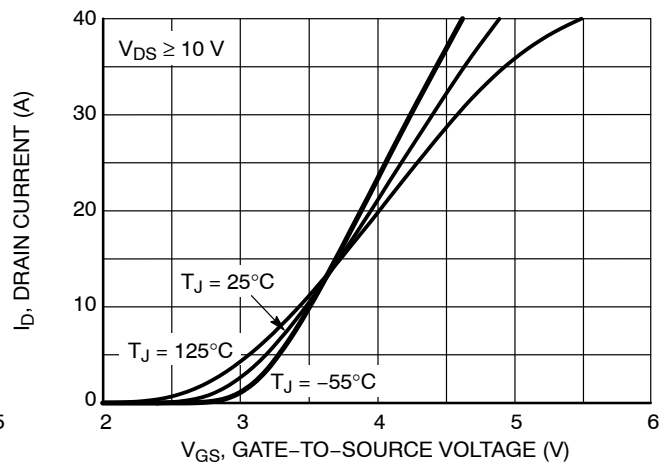


Figure 2. Transfer Characteristics

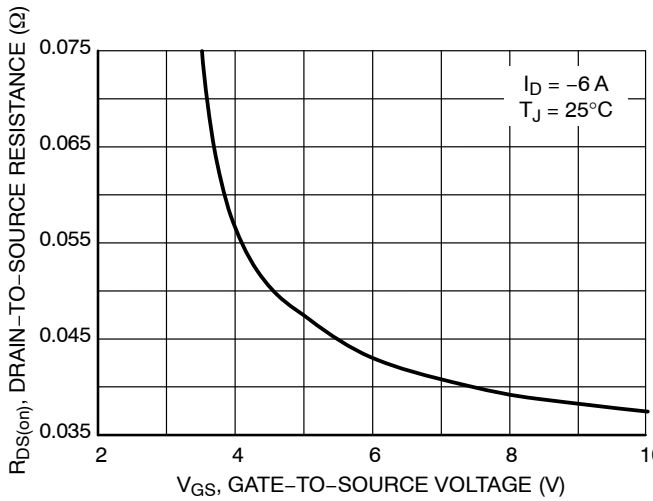


Figure 3. On-Resistance vs. Gate-to-Source Voltage

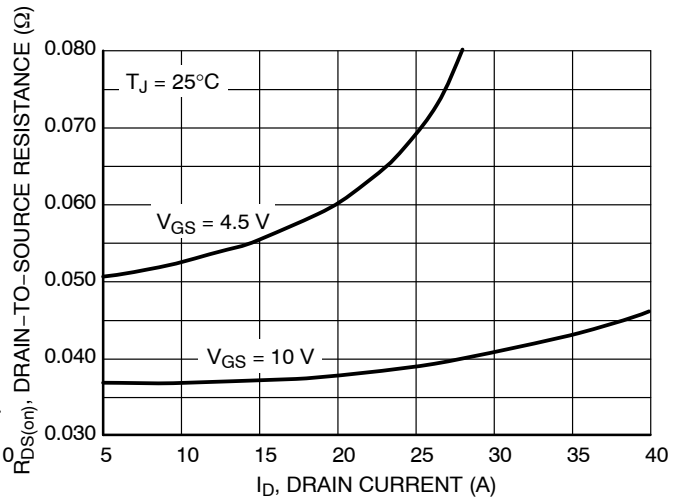


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

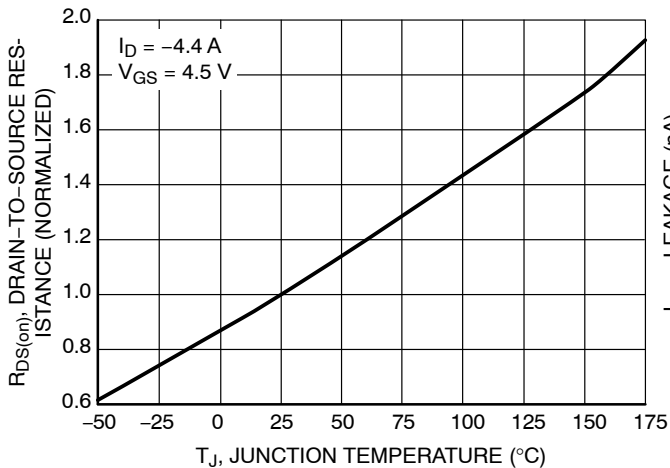


Figure 5. On-Resistance Variation with Temperature

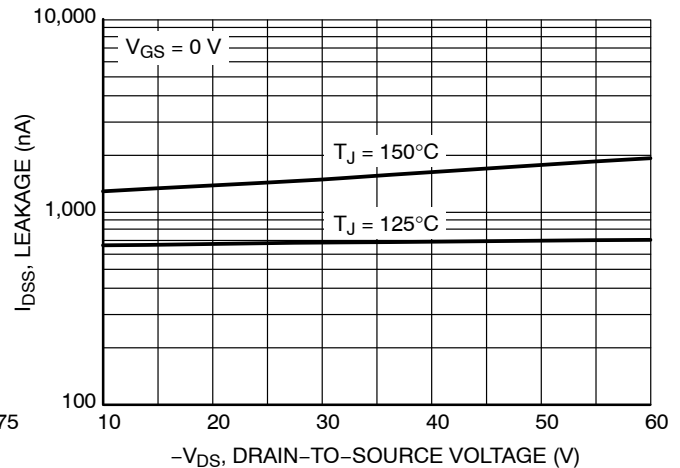


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

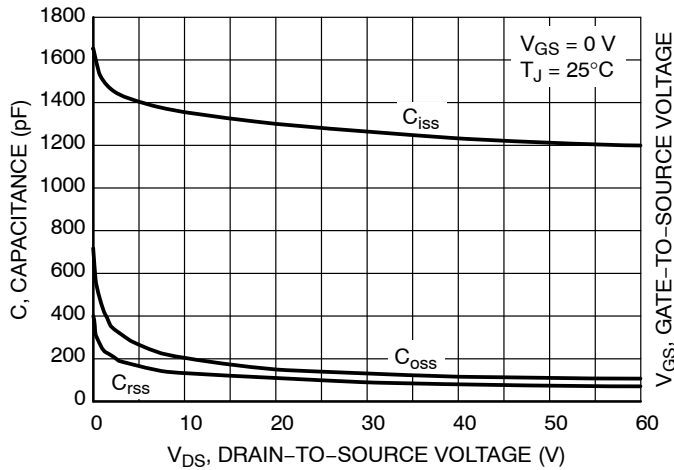


Figure 7. Capacitance Variation

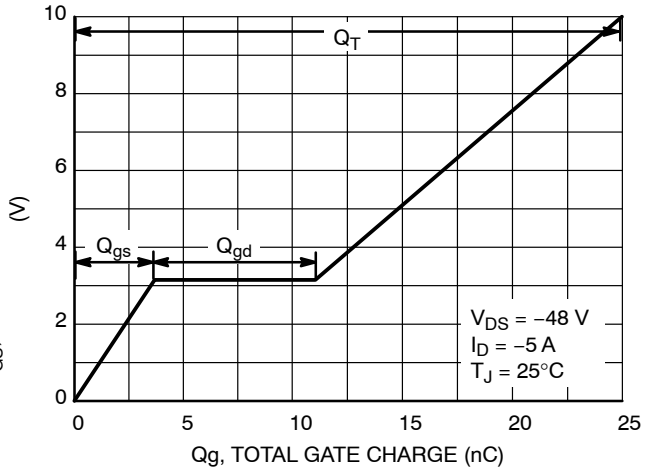


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

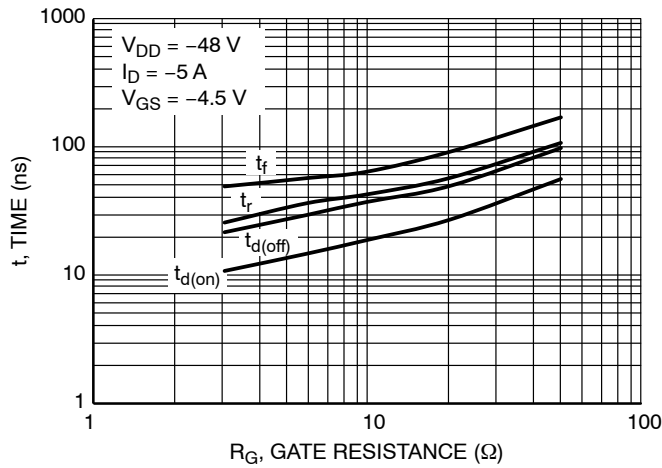


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

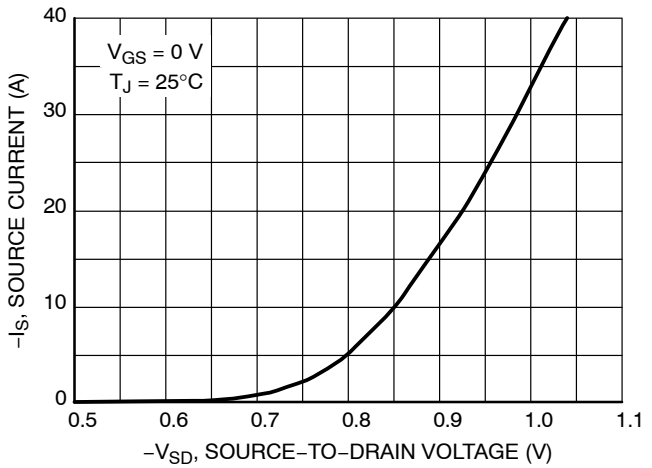


Figure 10. Diode Forward Voltage vs. Current

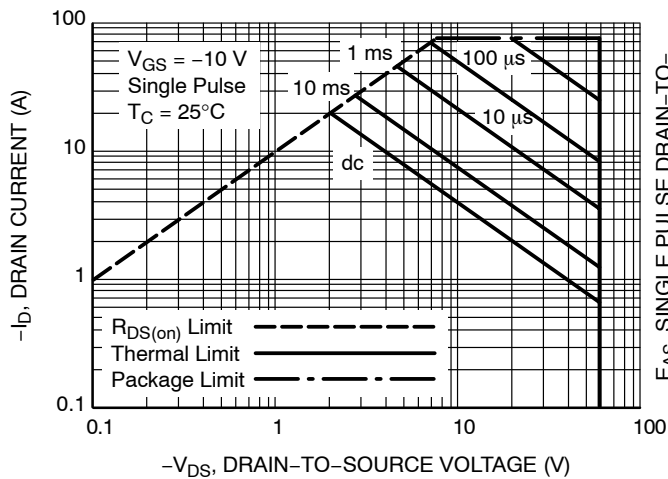


Figure 11. Maximum Rated Forward Biased Safe Operating Area

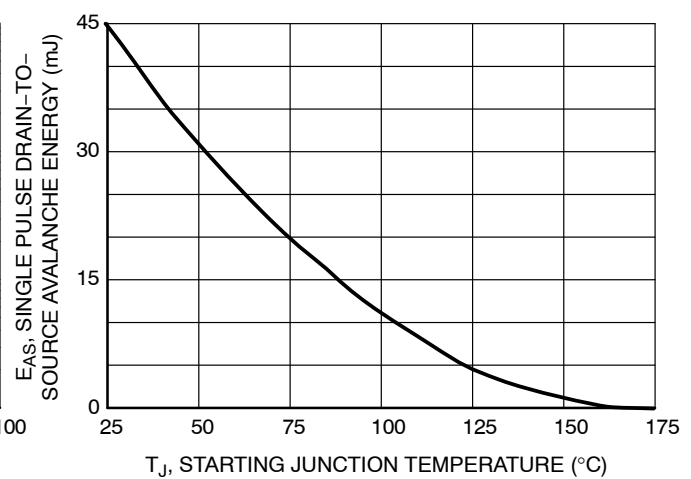


Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature

# NTTFS5116PL

## TYPICAL CHARACTERISTICS

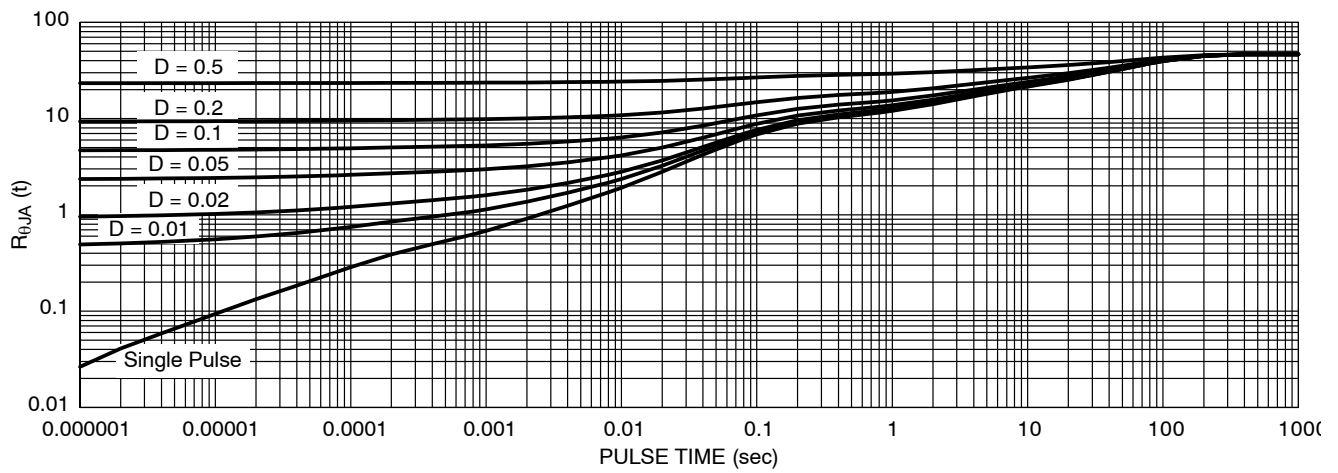


Figure 13. Thermal Response

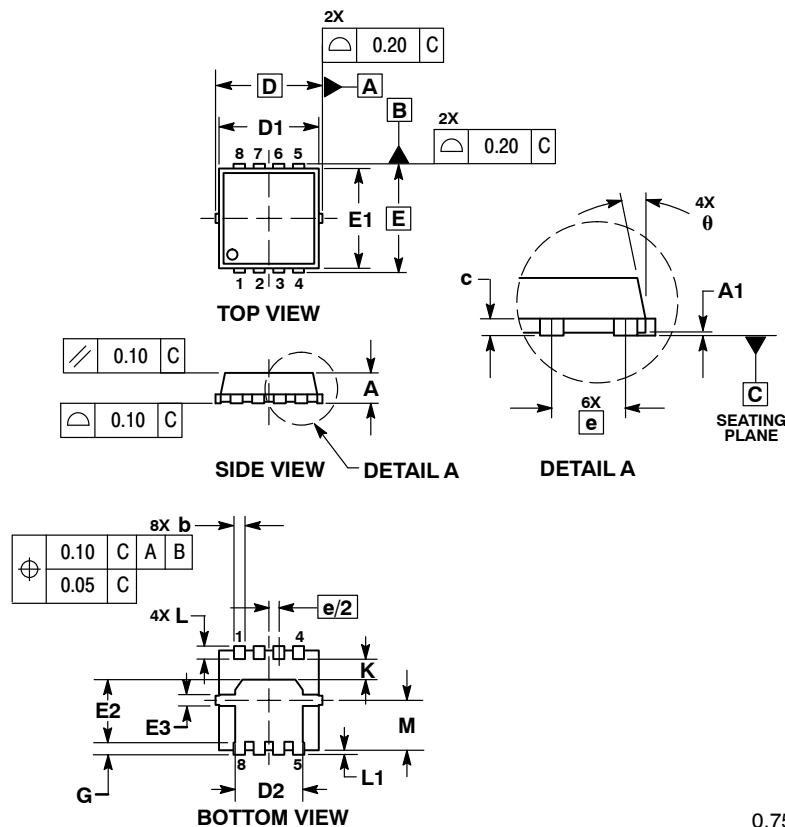
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



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

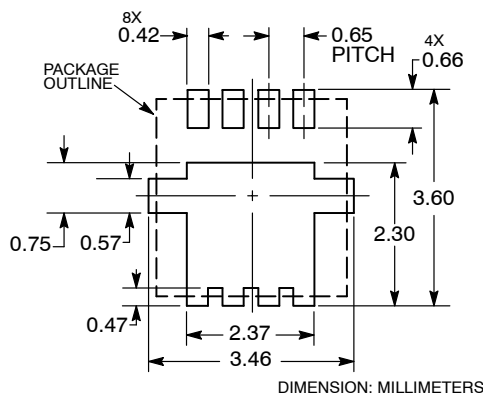
\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

## 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 |
| 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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