

# MOSFET - Power, Single N-Channel, Logic Level, SO-8FL

40 V, 0.49 mΩ, 455 A

## NTMFS0D5N04XL

### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Loss
- Low  $Q_{RR}$  with Soft Recovery to Minimize  $E_{RR}$  Loss and Voltage Spike
- Low  $Q_G$  and Capacitance to Minimize Driving and Switching Loss
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Typical Applications

- High Switching Frequency DC-DC Conversion
- Synchronous Rectification

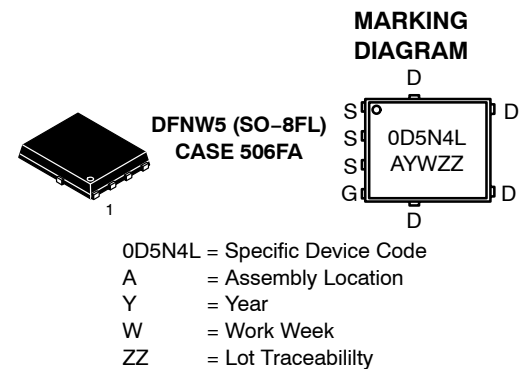
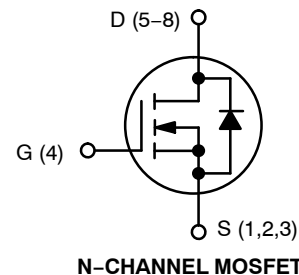
### MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$ unless otherwise stated)

| Parameter                                                                          |                                                |                        | Symbol                            | Value       | Unit |
|------------------------------------------------------------------------------------|------------------------------------------------|------------------------|-----------------------------------|-------------|------|
| Drain-to-Source Voltage                                                            |                                                |                        | V <sub>DSS</sub>                  | 40          | V    |
| Gate-to-Source Voltage                                                             |                                                |                        | V <sub>GS</sub>                   | ±20         | V    |
| Continuous Drain Current R <sub>θJC</sub> (Note 2)                                 | Steady State                                   | T <sub>C</sub> = 25°C  | I <sub>D</sub>                    | 455         | A    |
|                                                                                    |                                                | T <sub>C</sub> = 100°C |                                   | 322         |      |
| Power Dissipation R <sub>θJC</sub> (Note 2)                                        | Steady State                                   | T <sub>C</sub> = 25°C  | P <sub>D</sub>                    | 194         | W    |
|                                                                                    |                                                | T <sub>C</sub> = 100°C |                                   | 97.3        |      |
| Pulsed Drain Current                                                               | T <sub>A</sub> = 25°C, t <sub>p</sub> = 100 μs |                        | I <sub>DM</sub>                   | 2474        | A    |
| Pulsed Sourced Current (Body Diode)                                                |                                                |                        | I <sub>SM</sub>                   | 2474        |      |
| Operating Junction and Storage Temperature Range                                   |                                                |                        | T <sub>J</sub> , T <sub>STG</sub> | -55 to +175 | °C   |
| Source Current (Body Diode)                                                        |                                                |                        | I <sub>S</sub>                    | 306         | A    |
| Single Pulse Drain-to-Source Avalanche Energy (I <sub>Lpk</sub> = 94 A)            |                                                |                        | E <sub>AS</sub>                   | 1325        | mJ   |
| Lead Temperature Soldering Reflow for Soldering Purposes (1/8" from case for 10 s) |                                                |                        | T <sub>L</sub>                    | 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.

1. Surface-mounted on FR4 board using 1 in<sup>2</sup> pad size, 1 oz Cu pad.
2. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
3.  $R_{\theta JCT}$  Thermal Resistance - Junction to Case Top = 20  $^\circ\text{C}/\text{W}$ .

| $V_{(BR)DS}$ | $R_{DS(ON)}$ MAX | $I_D$ MAX |
|--------------|------------------|-----------|
| 40 V         | 0.49 mΩ @ 10 V   | 455 A     |
|              | 0.78 mΩ @ 4.5 V  |           |



### ORDERING INFORMATION

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

# NTMFS0D5N04XL

## THERMAL CHARACTERISTICS

| Parameter                                                       | Symbol          | Value | Unit |
|-----------------------------------------------------------------|-----------------|-------|------|
| Thermal Resistance, Junction-to-Case – Steady State (Note 2)    | $R_{\theta JC}$ | 0.77  | °C/W |
| Thermal Resistance, Junction-to-Ambient – Steady State (Note 2) | $R_{\theta JA}$ | 38    |      |

## 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                         | $V_{(BR)DSS}$                     | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$               | 40                        |      |     | V             |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $\Delta V_{(BR)DSS} / \Delta T_J$ | $I_D = 1\text{ mA}$ , referenced to $25^\circ\text{C}$ |                           | 16.5 |     | mV/°C         |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$                         | $V_{GS} = 0\text{ V}, V_{DS} = 40\text{ V}$            | $T_J = 25^\circ\text{C}$  |      | 10  | $\mu\text{A}$ |
|                                                           |                                   |                                                        | $T_J = 125^\circ\text{C}$ |      | 100 |               |
| Gate-to-Source Leakage Current                            | $I_{GSS}$                         | $V_{DS} = 0\text{ V}, V_{GS} = 20\text{ V}$            |                           |      | 100 | nA            |

### ON CHARACTERISTICS

|                                                |                                  |                                                                         |     |       |      |            |
|------------------------------------------------|----------------------------------|-------------------------------------------------------------------------|-----|-------|------|------------|
| Drain-to-Source On Resistance                  | $R_{DS(on)}$                     | $V_{GS} = 10\text{ V}, I_D = 50\text{ A}, T_J = 25^\circ\text{C}$       |     | 0.39  | 0.49 | m $\Omega$ |
|                                                |                                  | $V_{GS} = 4.5\text{ V}, I_D = 50\text{ A}, T_J = 25^\circ\text{C}$      |     | 0.54  | 0.78 |            |
| Gate Threshold Voltage                         | $V_{GS(TH)}$                     | $V_{GS} = V_{DS}, I_D = 330\text{ }\mu\text{A}, T_J = 25^\circ\text{C}$ | 1.3 |       | 2.2  | V          |
| Gate Threshold Voltage Temperature Coefficient | $\Delta V_{GS(TH)} / \Delta T_J$ | $V_{GS} = V_{DS}, I_D = 330\text{ }\mu\text{A}$                         |     | -5.35 |      | mV/°C      |
| Forward Transconductance                       | $g_{FS}$                         | $V_{DS} = 5\text{ V}, I_D = 50\text{ A}$                                |     | 277   |      | S          |

### CHARGES, CAPACITANCES & GATE RESISTANCE

|                              |              |                                                                  |  |      |  |          |
|------------------------------|--------------|------------------------------------------------------------------|--|------|--|----------|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}, f = 1\text{ MHz}$    |  | 9444 |  | pF       |
| Output Capacitance           | $C_{OSS}$    |                                                                  |  | 2468 |  |          |
| Reverse Transfer Capacitance | $C_{RSS}$    |                                                                  |  | 38   |  |          |
| Output Charge                | $Q_{OSS}$    | $V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}$                      |  | 95   |  | nC       |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 20\text{ V}, I_D = 50\text{ A}$ |  | 57   |  |          |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 10\text{ V}, V_{DS} = 20\text{ V}, I_D = 50\text{ A}$  |  | 127  |  |          |
| Threshold Gate Charge        | $Q_{G(TH)}$  |                                                                  |  | 15   |  |          |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                  |  | 27   |  |          |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                  |  | 9    |  |          |
| Gate Plateau Voltage         | $V_{GP}$     |                                                                  |  | 2.8  |  | V        |
| Gate Resistance              | $R_G$        | $f = 1\text{ MHz}$                                               |  | 0.48 |  | $\Omega$ |

### SWITCHING CHARACTERISTICS (Note 4)

|                     |              |                                                                                                                    |  |    |  |    |
|---------------------|--------------|--------------------------------------------------------------------------------------------------------------------|--|----|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | Resistive Load,<br>$V_{GS} = 0/10\text{ V}, V_{DS} = 20\text{ V},$<br>$I_D = 50\text{ A}, R_G = 2.5\text{ }\Omega$ |  | 11 |  | ns |
| Rise Time           | $t_r$        |                                                                                                                    |  | 10 |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |                                                                                                                    |  | 55 |  |    |
| Fall Time           | $t_f$        |                                                                                                                    |  | 24 |  |    |

### DIODE CHARACTERISTICS

|                         |          |                                                                                                         |                           |  |      |     |    |
|-------------------------|----------|---------------------------------------------------------------------------------------------------------|---------------------------|--|------|-----|----|
| Forward Diode Voltage   | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = 50\text{ A}$                                                                | $T_J = 25^\circ\text{C}$  |  | 0.78 | 1.2 | V  |
|                         |          |                                                                                                         | $T_J = 125^\circ\text{C}$ |  | 0.63 |     |    |
| Reverse Recovery Time   | $t_{RR}$ | $V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V},$<br>$di_S/dt = 300\text{ A}/\mu\text{s}, I_S = 50\text{ A}$ |                           |  | 40.5 |     | ns |
| Charge Time             | $t_a$    |                                                                                                         |                           |  | 22.2 |     |    |
| Discharge Time          | $t_b$    |                                                                                                         |                           |  | 18.3 |     |    |
| Reverse Recovery Charge | $Q_{RR}$ |                                                                                                         |                           |  | 108  |     | nC |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. Switching characteristics are independent of operating junction temperatures.

TYPICAL CHARACTERISTICS

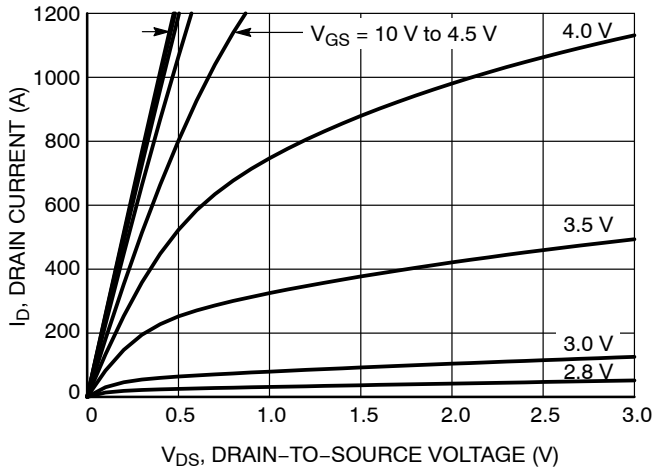


Figure 1. On-Region Characteristics

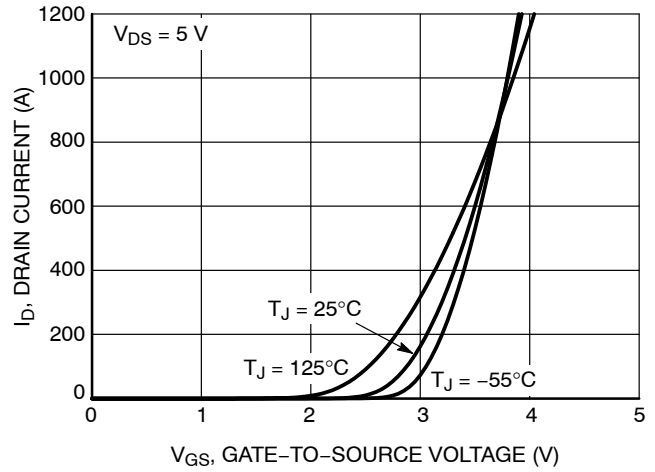


Figure 2. Transfer Characteristics

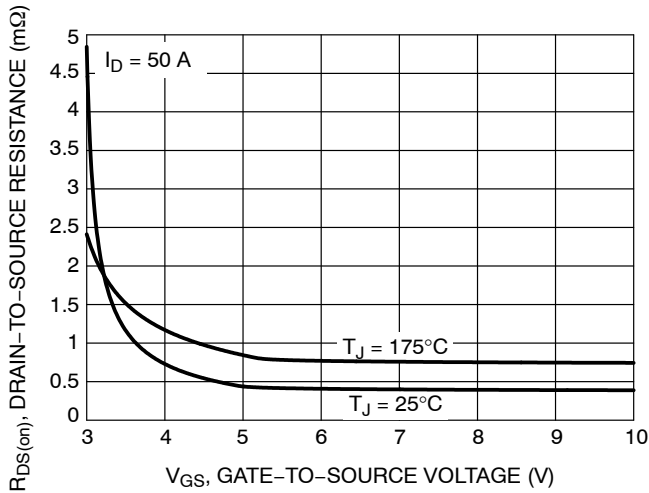


Figure 3. On-Resistance vs. Gate-to-Source Voltage

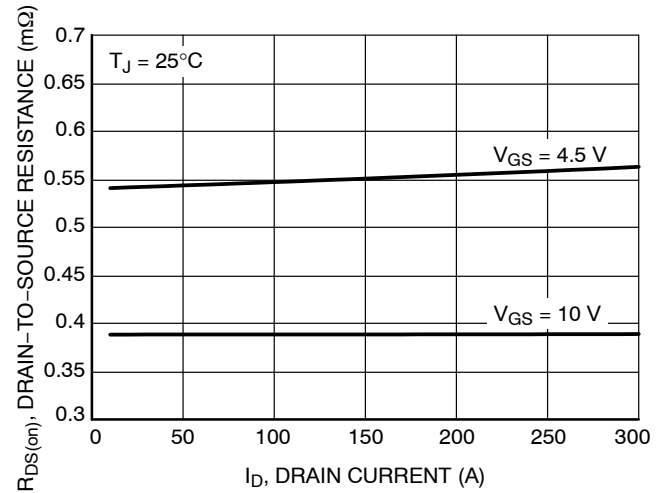


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

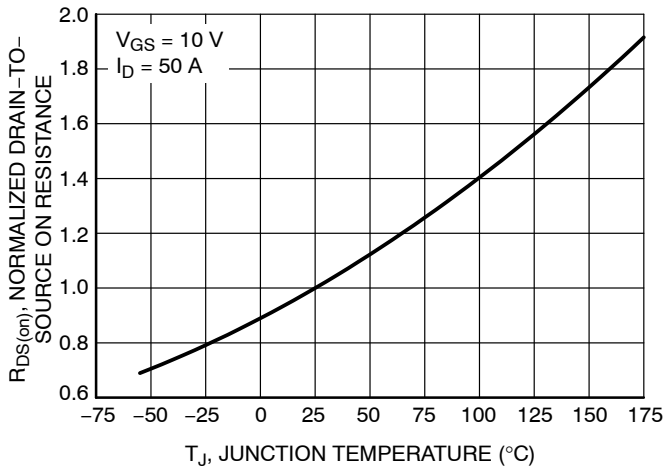


Figure 5. On-Resistance Variation with Temperature

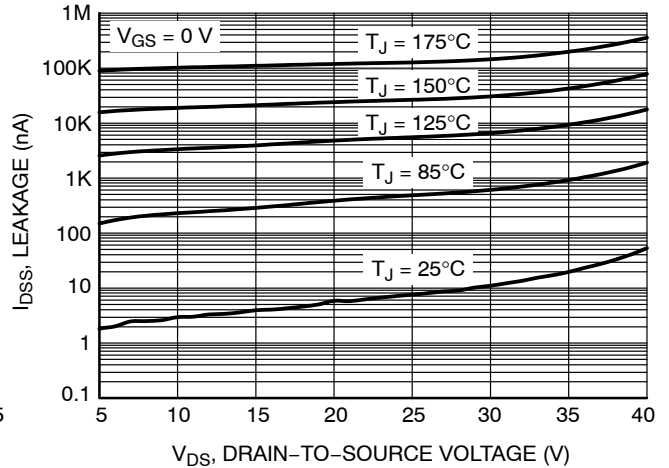


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

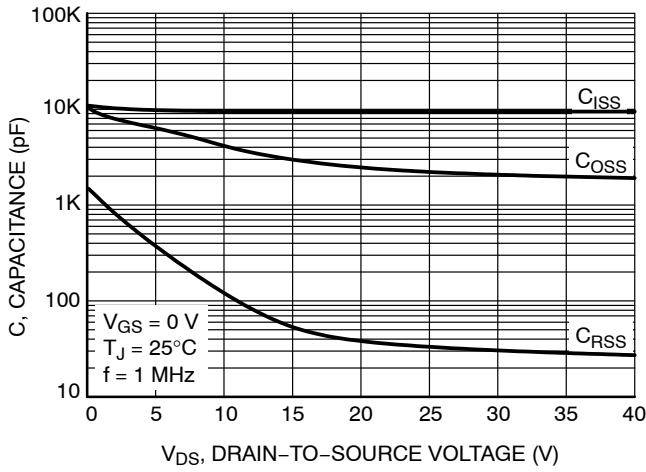


Figure 7. Capacitance Variation

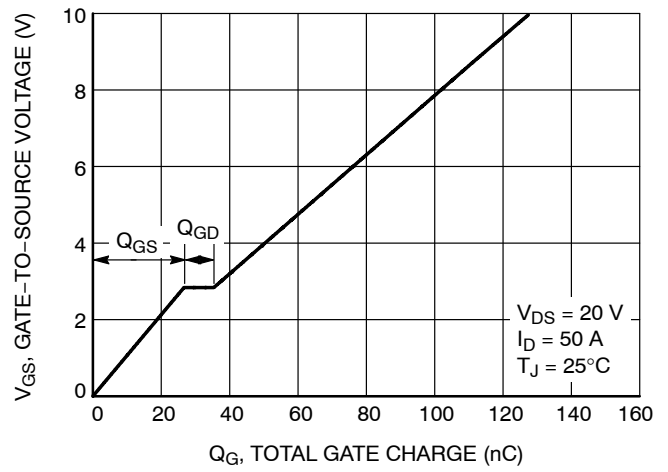


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

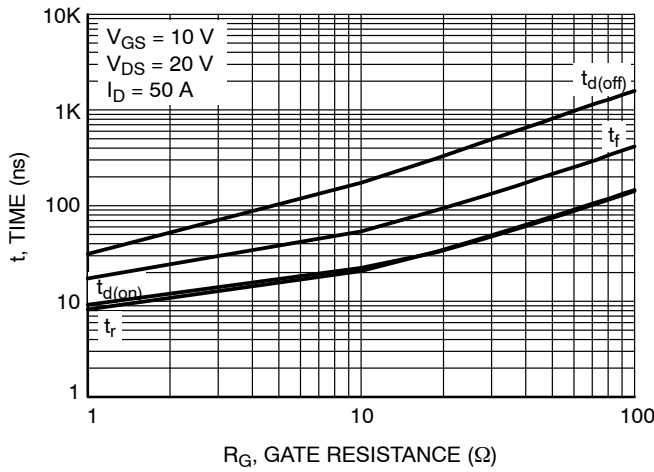


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

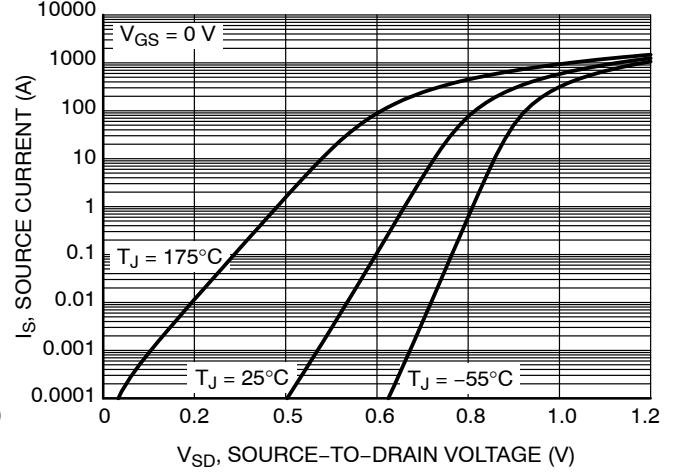


Figure 10. Diode Forward Voltage vs. Current

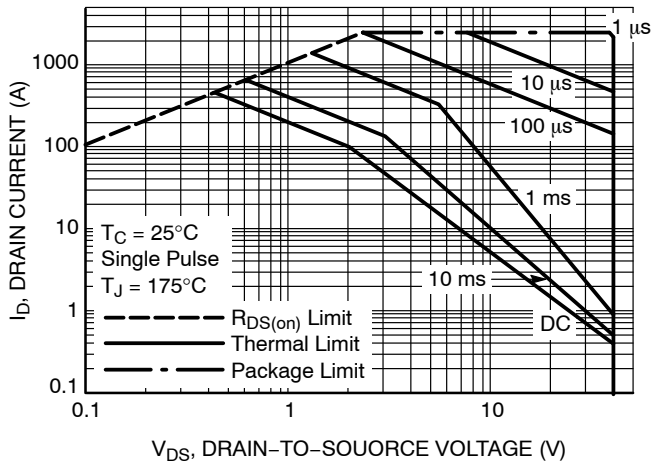


Figure 11. Safe Operating Area (SOA)

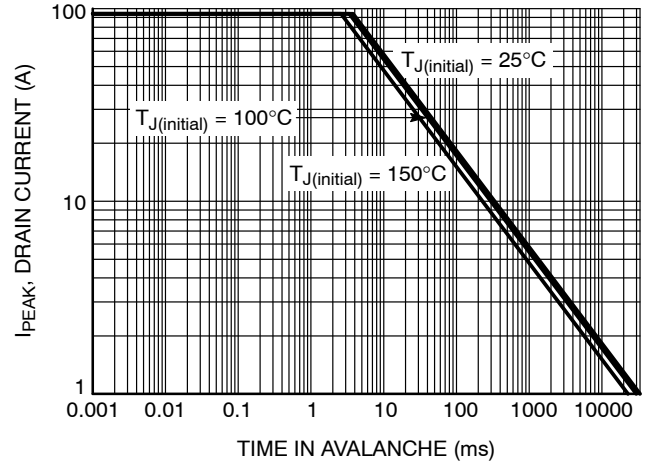
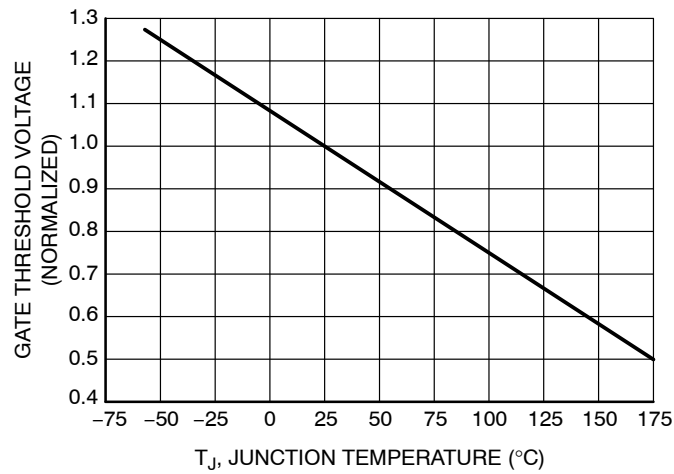


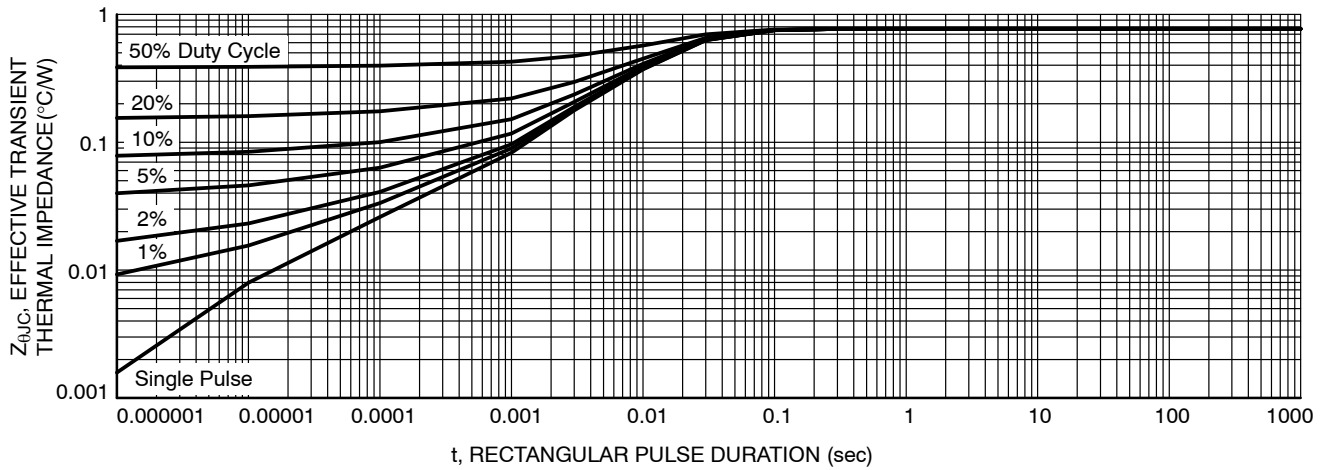
Figure 12. Avalanche Current vs. Pulse Time (UIS)

# NTMFS0D5N04XL

## TYPICAL CHARACTERISTICS



**Figure 13. Gate Threshold Voltage vs. Junction Temperature**



**Figure 14. Thermal Characteristics**

### DEVICE ORDERING INFORMATION

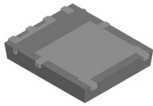
| Device           | Marking | Package            | Shipping <sup>†</sup> |
|------------------|---------|--------------------|-----------------------|
| NTMFS0D5N04XLT1G | 0D5N4L  | DFNW5<br>(Pb-Free) | 1500 / Tape & Reel    |

<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

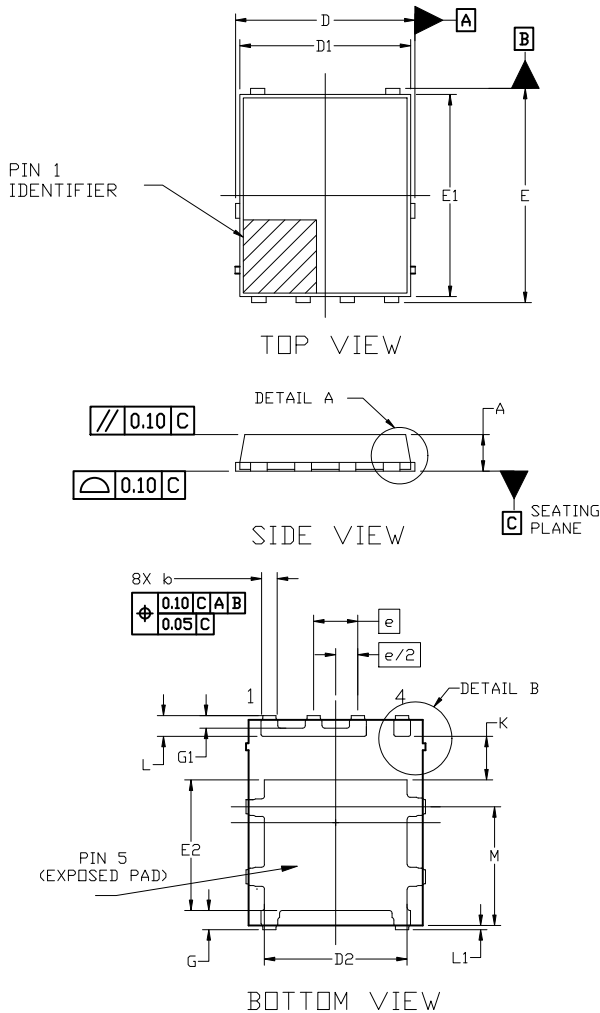
ON Semiconductor®

ON



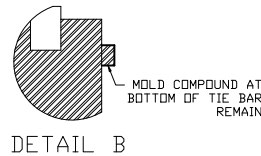
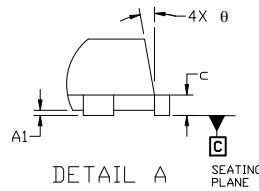
## DFN5 5x6, 1.27P CASE 506FA ISSUE O

DATE 16 FEB 2021



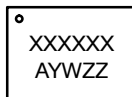
### NOTES:

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



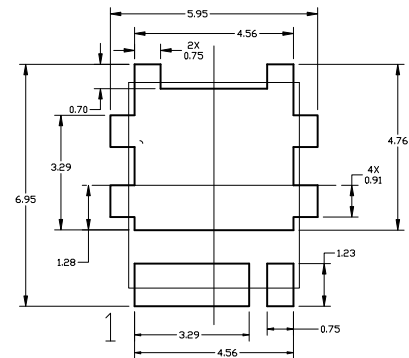
| MILLIMETERS |           |      |      |
|-------------|-----------|------|------|
| DIM         | MIN.      | NOM. | MAX. |
| A           | 0.90      | 1.00 | 1.10 |
| A1          | 0.00      | ---  | 0.05 |
| b           | 0.33      | 0.41 | 0.51 |
| c           | 0.23      | 0.28 | 0.33 |
| D           | 5.00      | 5.15 | 5.30 |
| D1          | 4.80      | 5.00 | 5.20 |
| D2          | 3.90      | 4.10 | 4.30 |
| E           | 6.00      | 6.15 | 6.30 |
| E1          | 5.70      | 5.90 | 6.10 |
| E2          | 3.55      | 3.75 | 3.95 |
| e           | 1.27 BSC  |      |      |
| G           | 0.50      | 0.55 | 0.70 |
| G1          | 0.26      | 0.36 | 0.46 |
| k           | 1.10      | 1.25 | 1.40 |
| L           | 0.50      | 0.60 | 0.70 |
| L1          | 0.150 REF |      |      |
| M           | 3.00      | 3.40 | 3.80 |
| θ           | 0°        | ---  | 12°  |

### GENERIC MARKING DIAGRAM\*



XXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
ZZ = Assembly Lot Code

\*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.



### 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.

|                  |                 |                                                                                                                                                                                     |
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