

# MOSFET - Power, Single N-Channel, STD Gate, SO-8FL

80 V, 4.5 mΩ, 94 A

## NTMFS4D5N08X

### Features

- Low  $Q_{RR}$ , Soft Recovery Body Diode
- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low  $Q_G$  and Capacitance to Minimize Driver Losses
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Typical Applications

- Synchronous Rectification (SR) in DC-DC and AC-DC
- Primary Switch in Isolated DC-DC Converter
- Motor Drives

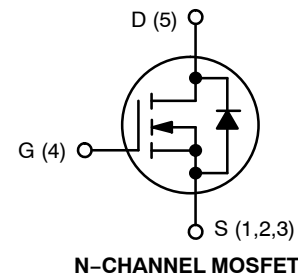
### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise stated)

| Parameter  | Symbol         | Value   | Unit             |
|--|----------------|---|------------------|
| Drain-to-Source Voltage  | $V_{DS}$       | 80  | V                |
| Gate-to-Source Voltage   | $V_{GS}$       | $\pm 20$  | V                |
| Continuous Drain Current (Note 1)                                  | $I_D$          | $T_C = 25^\circ\text{C}$                              | 94 A             |
|  |                | $T_C = 100^\circ\text{C}$                             | 67               |
| Power Dissipation (Note 1)   | $P_D$          | $T_C = 25^\circ\text{C}$                              | 82 W             |
| Pulsed Drain Current   | $I_{DM}$       | $T_C = 25^\circ\text{C}$ ,<br>$t_p = 100 \mu\text{s}$ | 360 A            |
| Operating Junction and Storage Temperature Range                   | $T_J, T_{STG}$ | -55 to +175   | $^\circ\text{C}$ |
| Source Current (Body Diode)  | $I_S$          | 139   | A                |
| Single Pulse Avalanche Energy ( $I_{PK} = 35 \text{ A}$ ) (Note 3) | $E_{AS}$       | 61  | mJ               |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s)  | $T_L$          | 260   | $^\circ\text{C}$ |

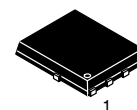
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. 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.  $E_{AS}$  of 61 mJ is based on started  $T_J = 25^\circ\text{C}$ ,  $I_{AS} = 35 \text{ A}$ ,  $V_{DD} = 64 \text{ V}$ ,  $V_{GS} = 10 \text{ V}$ , 100% avalanche tested.

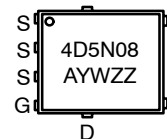
| $V_{(BR)DSS}$ | $R_{DS(ON)} \text{ MAX}$ | $I_D \text{ MAX}$ |
|---------------|--------------------------|-------------------|
| 80 V          | 4.5 mΩ @ 10 V            | 94 A              |



### MARKING DIAGRAM



DFN5 (SO-8FL)  
CASE 488AA



4D5N08 = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
ZZ = Lot Traceability

### ORDERING INFORMATION

See detailed ordering, marking and shipping information on page 3 of this data sheet.

# NTMFS4D5N08X

## THERMAL CHARACTERISTICS

| Parameter                               | Symbol          | Value | Unit |
|---|-----------------|-------|------|
| Thermal Resistance, Junction-to-Case    | $R_{\theta JC}$ | 1.8   | °C/W |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 39    |      |

4. Surface-mounted on FR4 board using 1 in<sup>2</sup> pad, 1 oz. Cu.

5.  $R_{\theta JA}$  is determined by the user's board design.

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

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

### OFF CHARACTERISTICS

|   |                                   |  |    |    |     |               |
|---|-----------------------------------|--|----|----|-----|---------------|
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$                     | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$               | 80 |    |     | V             |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $\Delta V_{(BR)DSS} / \Delta T_J$ | $I_D = 1\text{ mA}$ , Referenced to $25^\circ\text{C}$ |    | 32 |     | mV/°C         |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$                         | $V_{DS} = 80\text{ V}, T_J = 25^\circ\text{C}$         |    |    | 1.0 | $\mu\text{A}$ |
|   |                                   | $V_{DS} = 80\text{ V}, T_J = 125^\circ\text{C}$        |    |    | 250 |               |
| Gate-to-Source Leakage Current                            | $I_{GSS}$                         | $V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$            |    |    | 100 | nA            |

### ON CHARACTERISTICS

|  |                                  |  |     |      |     |            |
|--|----------------------------------|--|-----|------|-----|------------|
| Drain-to-Source On Resistance                  | $R_{DS(on)}$                     | $V_{GS} = 10\text{ V}, I_D = 19\text{ A}$      |     | 4.0  | 4.5 | m $\Omega$ |
|  |                                  | $V_{GS} = 6\text{ V}, I_D = 10\text{ A}$       |     | 6.1  | 9.1 |            |
| Gate Threshold Voltage                         | $V_{GS(TH)}$                     | $V_{GS} = V_{DS}, I_D = 96\text{ }\mu\text{A}$ | 2.4 |      | 3.6 | V          |
| Gate Threshold Voltage Temperature Coefficient | $\Delta V_{GS(TH)} / \Delta T_J$ | $V_{GS} = V_{DS}, I_D = 96\text{ }\mu\text{A}$ |     | -7.0 |     | mV/°C      |
| Forward Transconductance                       | $g_{FS}$                         | $V_{DS} = 5\text{ V}, I_D = 19\text{ A}$       |     | 61   |     | S          |

### CHARGES, CAPACITANCES & GATE RESISTANCE

|                              |              |   |  |      |  |          |
|------------------------------|--------------|---|--|------|--|----------|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, V_{DS} = 40\text{ V}, f = 1\text{ MHz}$   |  | 1710 |  | pF       |
| Output Capacitance           | $C_{OSS}$    |   |  | 490  |  |          |
| Reverse Transfer Capacitance | $C_{RSS}$    |   |  | 8.0  |  |          |
| Output Charge                | $Q_{OSS}$    |   |  | 35   |  |          |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 6\text{ V}, V_{DD} = 40\text{ V}, I_D = 19\text{ A}$  |  | 15   |  | nC       |
|                              |              | $V_{GS} = 10\text{ V}, V_{DD} = 40\text{ V}, I_D = 19\text{ A}$ |  | 24   |  |          |
| Threshold Gate Charge        | $Q_{G(TH)}$  |   |  | 5.3  |  |          |
| Gate-to-Source Charge        | $Q_{GS}$     |   |  | 8.1  |  |          |
| Gate-to-Drain Charge         | $Q_{GD}$     |   |  | 3.8  |  |          |
| Gate Plateau Voltage         | $V_{GP}$     |   |  | 4.7  |  | V        |
| Gate Resistance              | $R_G$        | $f = 1\text{ MHz}$  |  | 1.5  |  | $\Omega$ |

### SWITCHING CHARACTERISTICS

|                     |              |  |  |    |  |    |
|---------------------|--------------|--|--|----|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | Resistive Load,<br>$V_{GS} = 0/10\text{ V}, V_{DD} = 40\text{ V},$<br>$I_D = 19\text{ A}, R_G = 2.5\text{ }\Omega$ |  | 11 |  | ns |
| Rise Time           | $t_r$        |  |  | 24 |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |  |  | 16 |  |    |
| Fall Time           | $t_f$        |  |  | 30 |  |    |

### SOURCE-TO-DRAIN DIODE CHARACTERISTICS

|                       |          |   |  |     |     |   |
|-----------------------|----------|---|--|-----|-----|---|
| Forward Diode Voltage | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = 19\text{ A}, T_J = 25^\circ\text{C}$  |  | 0.8 | 1.2 | V |
|                       |          | $V_{GS} = 0\text{ V}, I_S = 19\text{ A}, T_J = 125^\circ\text{C}$ |  | 0.7 |     |   |

# NTMFS4D5N08X

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

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

### SOURCE-TO-DRAIN DIODE CHARACTERISTICS

|                         |                 |  |  |     |  |    |
|-------------------------|-----------------|--|--|-----|--|----|
| Reverse Recovery Time   | t <sub>RR</sub> | V <sub>GS</sub> = 0 V, dI/dt = 1000 A/μs,<br>I <sub>S</sub> = 19 A, V <sub>DD</sub> = 40 V |  | 12  |  | ns |
| Charge Time             | t <sub>a</sub>  |  |  | 9.0 |  |    |
| Discharge Time          | t <sub>b</sub>  |  |  | 21  |  |    |
| Reverse Recovery Charge | Q <sub>RR</sub> |  |  | 111 |  | 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.

### DEVICE ORDERING INFORMATION

| Device          | Marking | Package           | Shipping <sup>†</sup> |
|-----------------|---------|-------------------|-----------------------|
| NTMFS4D5N08XT1G | 4D5N08  | DFN5<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.

# NTMFS4D5N08X

## TYPICAL CHARACTERISTICS

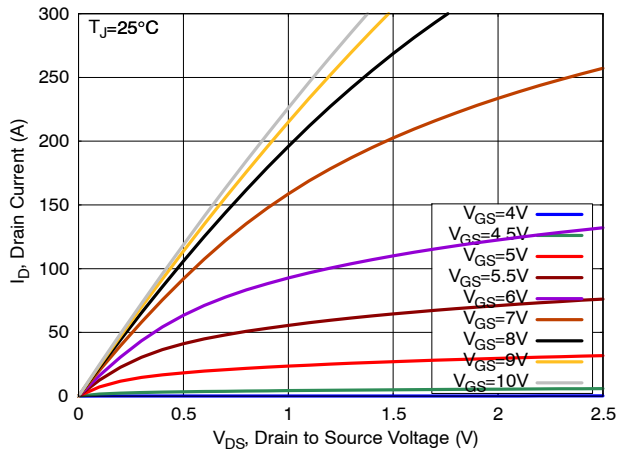


Figure 1. On-Region Characteristics

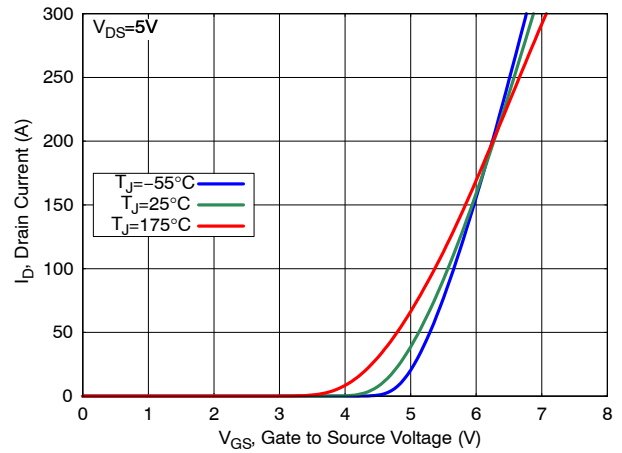


Figure 2. Transfer Characteristics

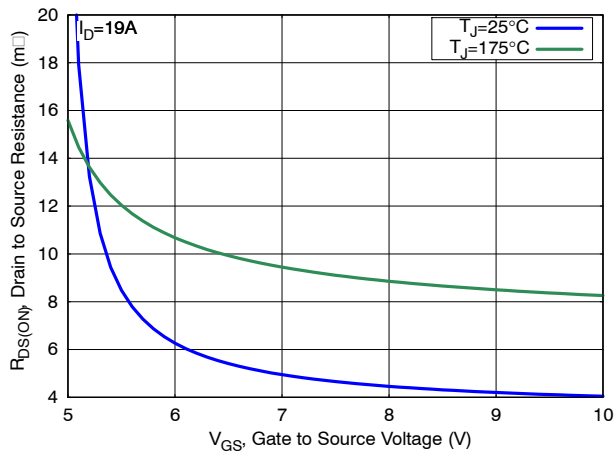


Figure 3. On-Resistance vs. Gate Voltage

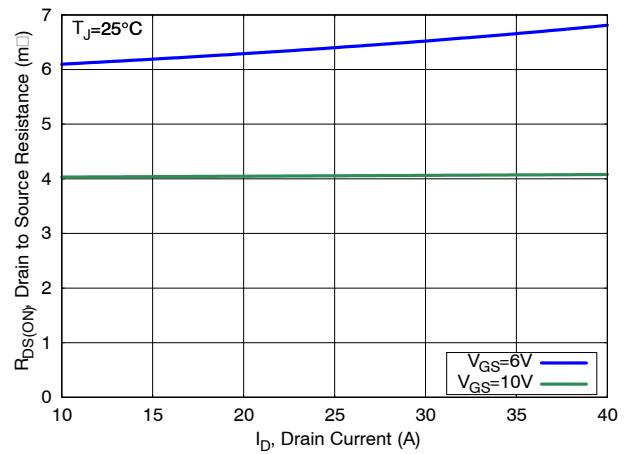


Figure 4. On-Resistance vs. Drain Current

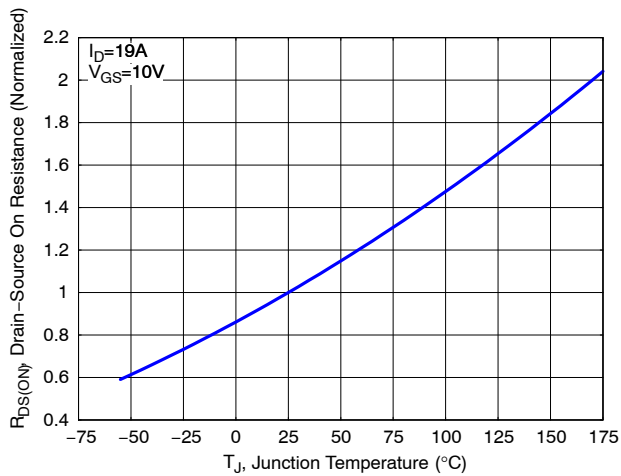


Figure 5. Normalized ON Resistance vs. Junction Temperature

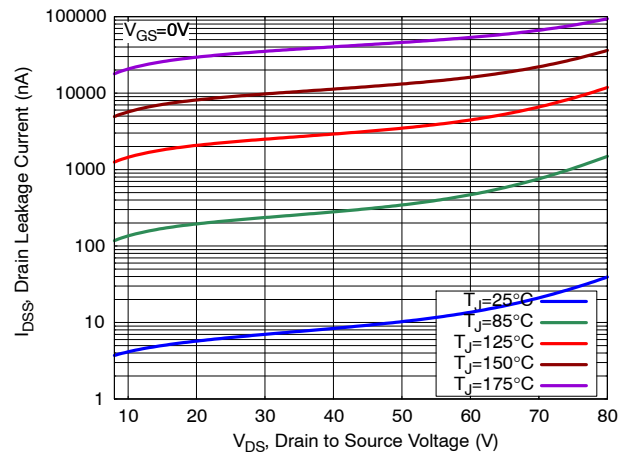


Figure 6. Drain Leakage Current vs. Drain Voltage

# NTMFS4D5N08X

## TYPICAL CHARACTERISTICS

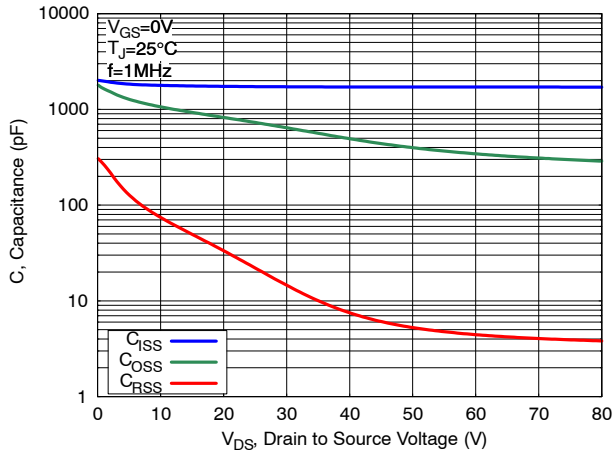


Figure 7. Capacitance Characteristics

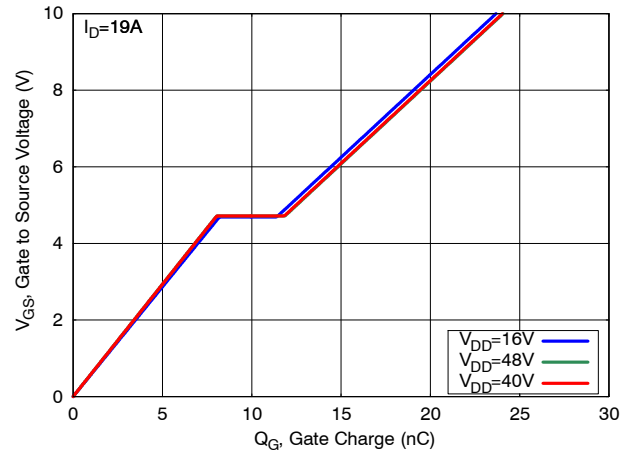


Figure 8. Gate Charge Characteristics

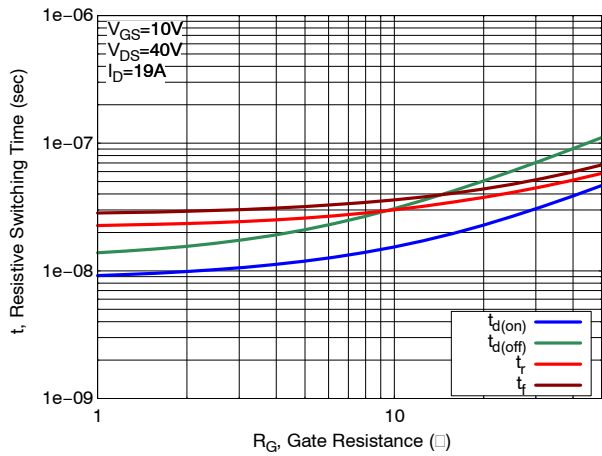


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

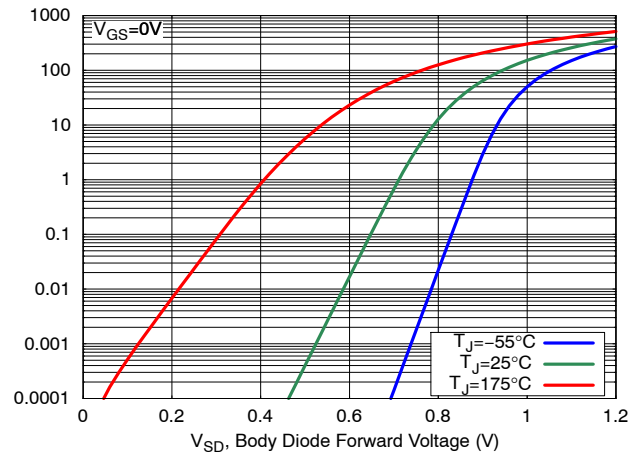


Figure 10. Diode Forward Characteristics

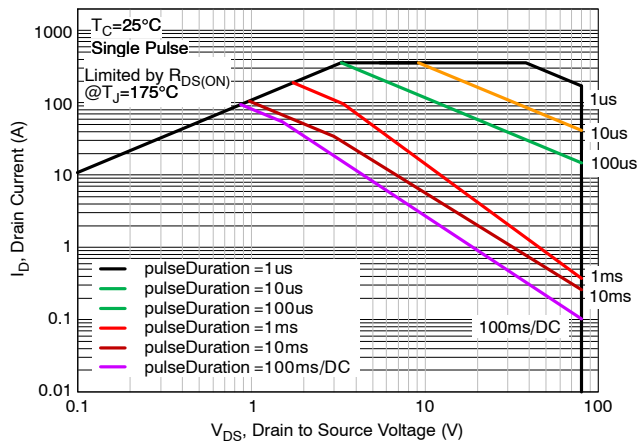


Figure 11. Safe Operating Area (SOA)

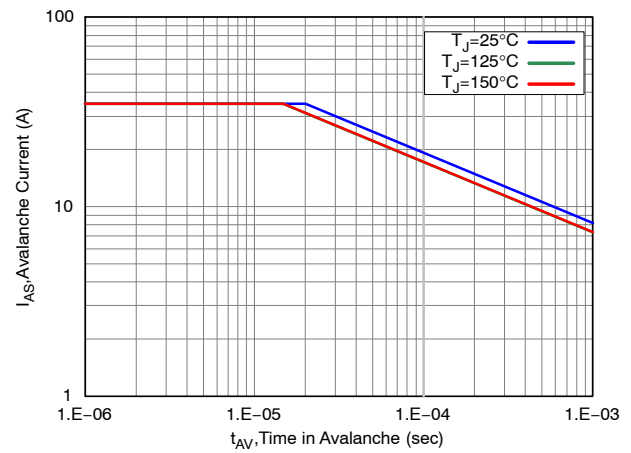
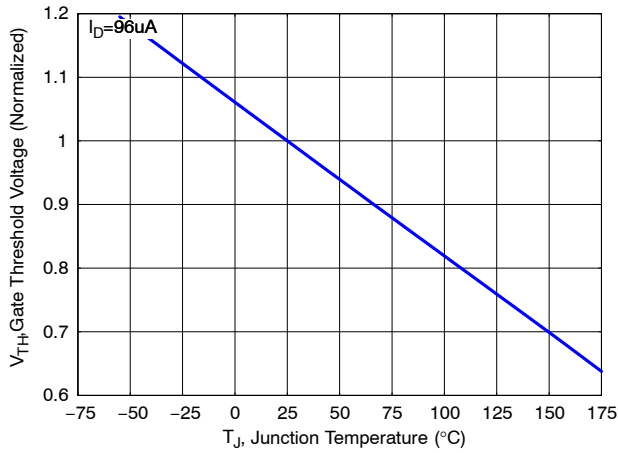


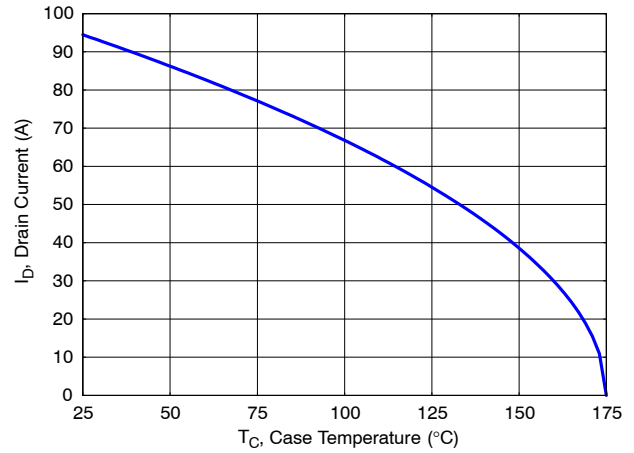
Figure 12. Avalanche Current vs Pulse Time (UIS)

# NTMFS4D5N08X

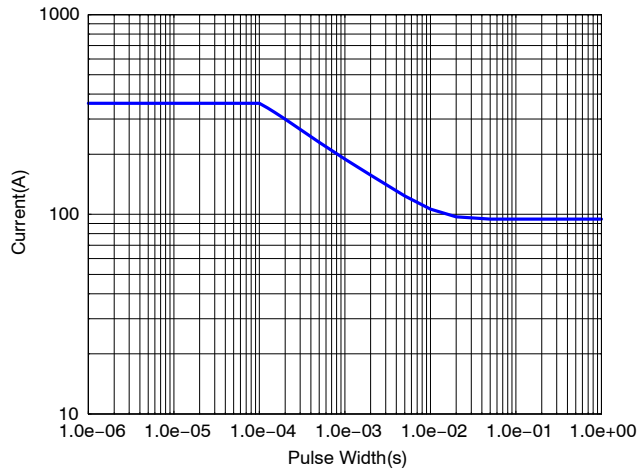
## TYPICAL CHARACTERISTICS



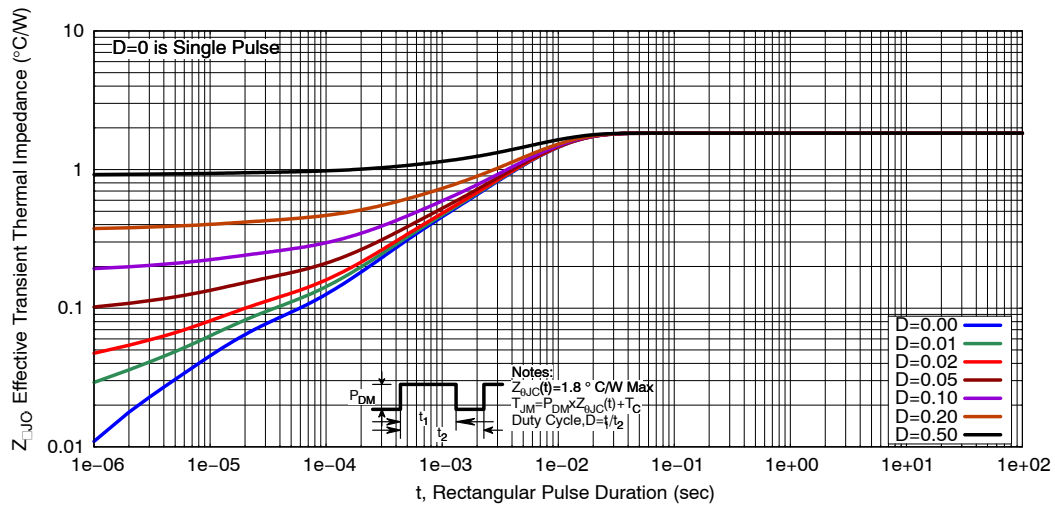
**Figure 13. Gate Threshold Voltage vs Junction Temperature**



**Figure 14. Maximum Current vs. Case Temperature**



**Figure 15. IDM vs. Pulse Width**



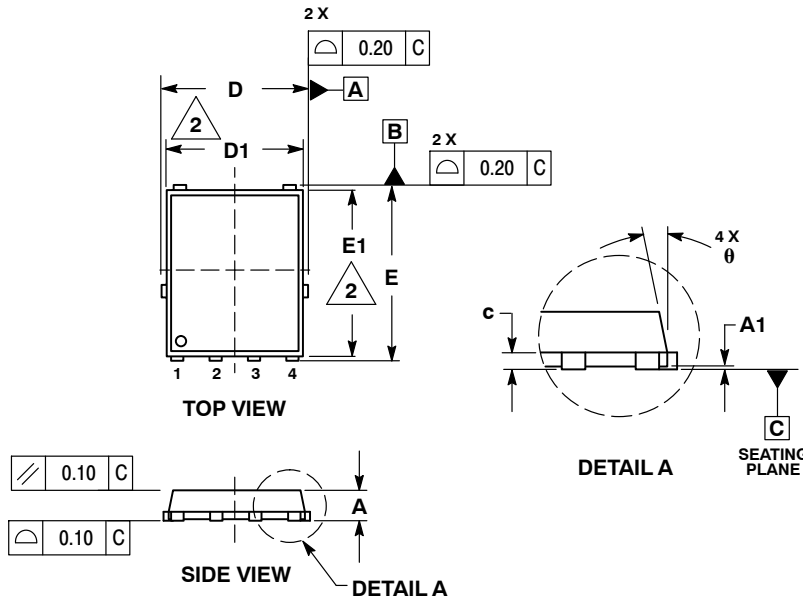
**Figure 16. Transient Thermal Response**



SCALE 2:1

**DFN5 5x6, 1.27P**  
**(SO-8FL)**  
**CASE 488AA**  
**ISSUE N**

DATE 25 JUN 2018



## NOTES:

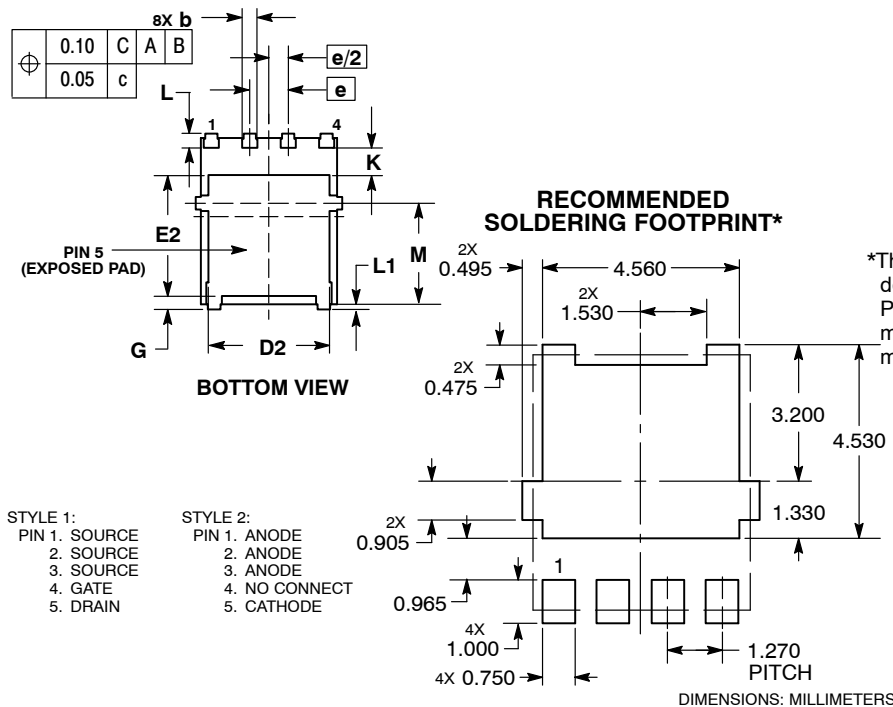
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION D1 AND E1 DO NOT INCLUDE MOLD FLASH PROTRUSIONS OR GATE BURRS.

| DIM | MILLIMETERS |       |      |
|-----|-------------|-------|------|
|     | 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  | 4.70        | 4.90  | 5.10 |
| D2  | 3.80        | 4.00  | 4.20 |
| E   | 6.00        | 6.15  | 6.30 |
| E1  | 5.70        | 5.90  | 6.10 |
| E2  | 3.45        | 3.65  | 3.85 |
| e   | 1.27 BSC    |       |      |
| G   | 0.51        | 0.575 | 0.71 |
| K   | 1.20        | 1.35  | 1.50 |
| L   | 0.51        | 0.575 | 0.71 |
| L1  | 0.125 REF   |       |      |
| M   | 3.00        | 3.40  | 3.80 |
| θ   | 0°          | ---   | 12°  |

**GENERIC**  
**MARKING DIAGRAM\***


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

\*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.



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

|                         |                                 |  |
|-------------------------|---------------------------------|--|
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