

# MOSFET - Power, Single N-Channel, SO8FL 40 V, 1.3 mΩ, 195 A

## NTMFS1D3N04XM

### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low Capacitance to Minimize Driver Losses
- Small Footprint (5 x 6 mm) with Compact Design
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

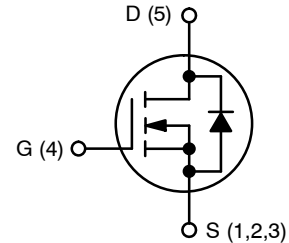
- Motor Drive
- Battery Protection
- ORing

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

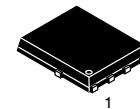
| Parameter                                                            |                                                  | Symbol                            | Value       | Unit |
|----------------------------------------------------------------------|--------------------------------------------------|-----------------------------------|-------------|------|
| Drain-to-Source Voltage                                              |                                                  | V <sub>DSS</sub>                  | 40          | V    |
| Gate-to-Source Voltage                                               | DC                                               | V <sub>GS</sub>                   | ±20         | V    |
| Continuous Drain Current                                             | T <sub>C</sub> = 25°C                            | I <sub>D</sub>                    | 195         | A    |
|                                                                      | T <sub>C</sub> = 100°C                           |                                   | 138         |      |
| Power Dissipation                                                    | T <sub>C</sub> = 25°C                            | P <sub>D</sub>                    | 90          | W    |
| Continuous Drain Current<br>R <sub>θJA</sub>                         | T <sub>A</sub> = 25°C                            | I <sub>DA</sub>                   | 40          | A    |
|                                                                      | T <sub>A</sub> = 100°C                           |                                   | 28          |      |
| Pulsed Drain Current                                                 | T <sub>C</sub> = 25°C,<br>t <sub>p</sub> = 10 μs | I <sub>DM</sub>                   | 1175        | A    |
| 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>                    | 74.5        | A    |
| Single Pulse Avalanche Energy<br>(I <sub>PK</sub> = 11.1 A)          |                                                  | E <sub>AS</sub>                   | 306         | mJ   |
| Lead Temperature for Soldering Purposes<br>(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.

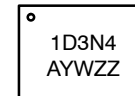
| $V_{(BR)DSS}$ | $R_{DS(on)} \text{ MAX}$         | $I_D \text{ MAX}$ |
|---------------|----------------------------------|-------------------|
| 40 V          | 1.3 mΩ @ $V_{GS} = 10 \text{ V}$ | 195 A             |



N-CHANNEL MOSFET



SO-8FL  
CASE 488AA  
(DFN5)



1D3N4 = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
ZZ = Assembly Lot Code

### ORDERING INFORMATION

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

# NTMFS1D3N04XM

## THERMAL CHARACTERISTICS

| Parameter                                            | Symbol          | Value | Unit |
|------------------------------------------------------|-----------------|-------|------|
| Thermal Resistance, Junction-to-Case (Note 2)        | $R_{\theta JC}$ | 1.67  | °C/W |
| Thermal Resistance, Junction-to-Ambient (Notes 1, 2) | $R_{\theta JA}$ | 40.1  |      |

- Surface mounted on FR4 board using 650 mm<sup>2</sup>, 2 oz Cu pad.
- The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.

## 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                         | $V_{(BR)DSS}$                     | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 25^\circ\text{C}$ | 40 |    |     | V             |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $\Delta V_{(BR)DSS} / \Delta T_J$ | $I_D = 1\text{ mA}$ , Referenced to $25^\circ\text{C}$           |    | 15 |     | mV/°C         |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$                         | $V_{DS} = 40\text{ V}, T_J = 25^\circ\text{C}$                   |    |    | 10  | $\mu\text{A}$ |
|                                                           |                                   | $V_{DS} = 40\text{ V}, T_J = 125^\circ\text{C}$                  |    |    | 100 |               |
| Gate-to-Source Leakage Current                            | $I_{GSS}$                         | $V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$                      |    |    | 100 | nA            |

### ON CHARACTERISTICS

|                                                |                                  |                                                                         |     |       |     |            |
|------------------------------------------------|----------------------------------|-------------------------------------------------------------------------|-----|-------|-----|------------|
| Drain-to-Source On Resistance                  | $R_{DS(on)}$                     | $V_{GS} = 10\text{ V}, I_D = 20\text{ A}, T_J = 25^\circ\text{C}$       |     | 1.17  | 1.3 | m $\Omega$ |
| Gate Threshold Voltage                         | $V_{GS(TH)}$                     | $V_{GS} = V_{DS}, I_D = 100\text{ }\mu\text{A}, T_J = 25^\circ\text{C}$ | 2.5 | 3.0   | 3.5 | V          |
| Gate Threshold Voltage Temperature Coefficient | $\Delta V_{GS(TH)} / \Delta T_J$ | $V_{GS} = V_{DS}, I_D = 100\text{ }\mu\text{A}$                         |     | -7.23 |     | mV/°C      |
| Forward Trans-conductance                      | $g_{FS}$                         | $V_{DS} = 5\text{ V}, I_D = 20\text{ A}$                                |     | 105   |     | S          |

### CHARGES, CAPACITANCES & GATE RESISTANCE

|                              |              |                                                                 |  |      |  |          |
|------------------------------|--------------|-----------------------------------------------------------------|--|------|--|----------|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}, f = 1\text{ MHz}$   |  | 2473 |  | pF       |
| Output Capacitance           | $C_{OSS}$    |                                                                 |  | 1763 |  |          |
| Reverse Transfer Capacitance | $C_{RSS}$    |                                                                 |  | 37.3 |  |          |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 10\text{ V}, V_{DD} = 20\text{ V}; I_D = 50\text{ A}$ |  | 38.5 |  | nC       |
| Threshold Gate Charge        | $Q_{G(TH)}$  |                                                                 |  | 7.27 |  |          |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                 |  | 11.3 |  |          |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                 |  | 7.07 |  |          |
| Gate Resistance              | $R_G$        | $f = 1\text{ MHz}$                                              |  | 1.21 |  | $\Omega$ |

### SWITCHING CHARACTERISTICS

|                     |              |                                                                                                                  |  |      |  |    |
|---------------------|--------------|------------------------------------------------------------------------------------------------------------------|--|------|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | Resistive Load,<br>$V_{GS} = 0/10\text{ V}, V_{DD} = 20\text{ V},$<br>$I_D = 50\text{ A}, R_G = 0\text{ }\Omega$ |  | 20   |  | ns |
| Rise Time           | $t_r$        |                                                                                                                  |  | 6.27 |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |                                                                                                                  |  | 29.2 |  |    |
| Fall Time           | $t_f$        |                                                                                                                  |  | 5.47 |  |    |

### SOURCE-TO-DRAIN DIODE CHARACTERISTICS

|                         |          |                                                                                                       |  |      |     |    |
|-------------------------|----------|-------------------------------------------------------------------------------------------------------|--|------|-----|----|
| Forward Diode Voltage   | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = 20\text{ A}, T_J = 25^\circ\text{C}$                                      |  | 0.79 | 1.2 | V  |
|                         |          | $V_{GS} = 0\text{ V}, I_S = 20\text{ A}, T_J = 125^\circ\text{C}$                                     |  | 0.63 |     |    |
| Reverse Recovery Time   | $t_{RR}$ | $V_{GS} = 0\text{ V}, I_S = 50\text{ A},$<br>$di/dt = 100\text{ A}/\mu\text{s}, V_{DD} = 20\text{ V}$ |  | 47.1 |     | ns |
| Charge Time             | $t_a$    |                                                                                                       |  | 23.4 |     |    |
| Discharge Time          | $t_b$    |                                                                                                       |  | 23.7 |     |    |
| Reverse Recovery Charge | $Q_{RR}$ |                                                                                                       |  | 53.7 |     | 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.

TYPICAL CHARACTERISTICS

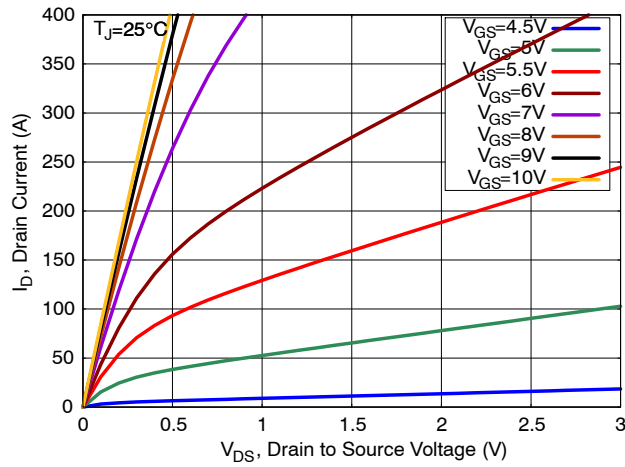


Figure 1. On-Region Characteristics

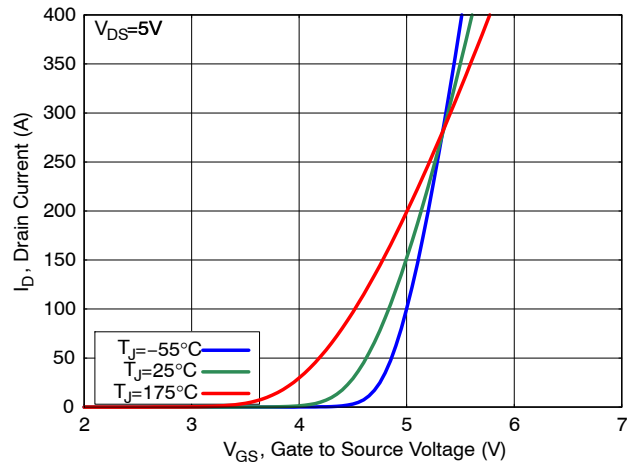


Figure 2. Transfer Characteristics

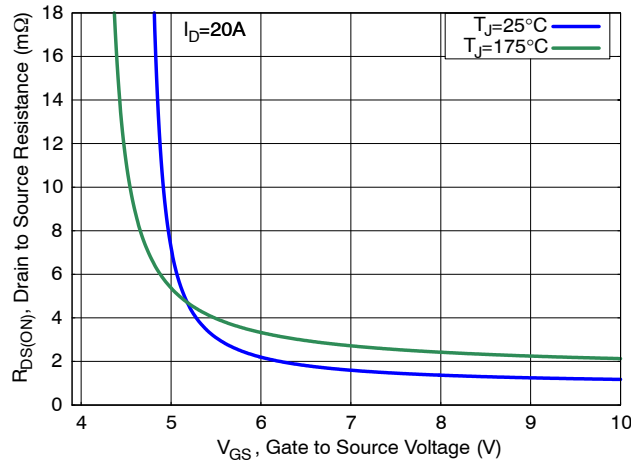


Figure 3. On-Resistance vs.  $V_{GS}$

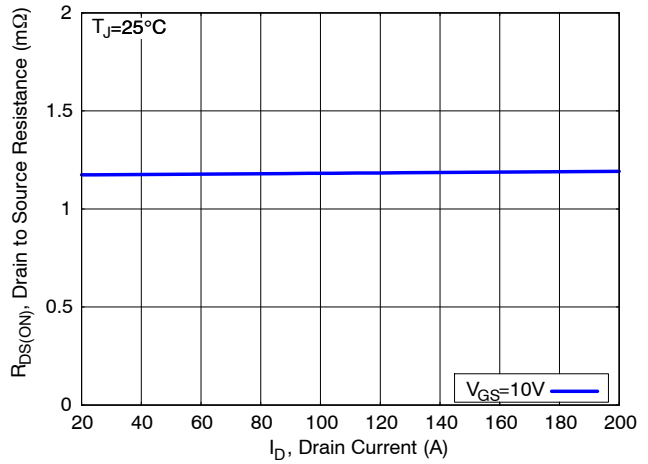


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

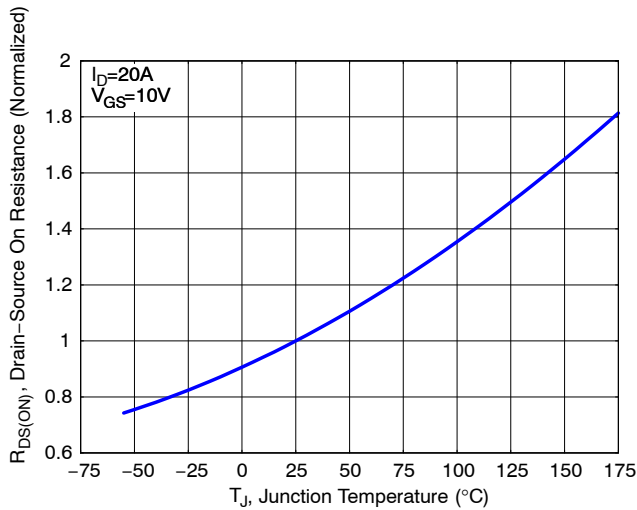


Figure 5. On-Resistance Variation with Temperature

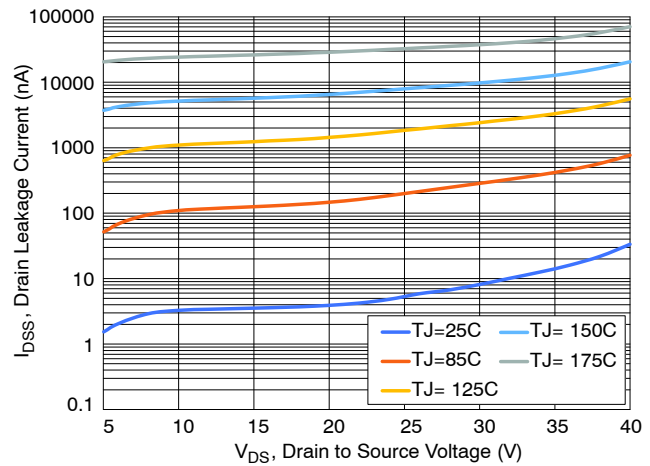


Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NTMFS1D3N04XM

## TYPICAL CHARACTERISTICS

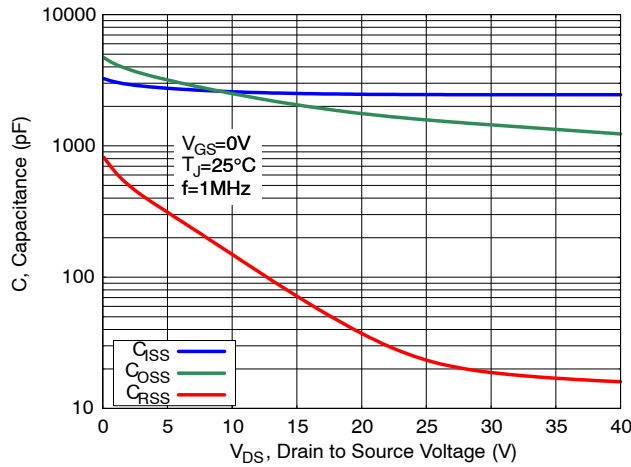


Figure 7. Capacitance Characteristics

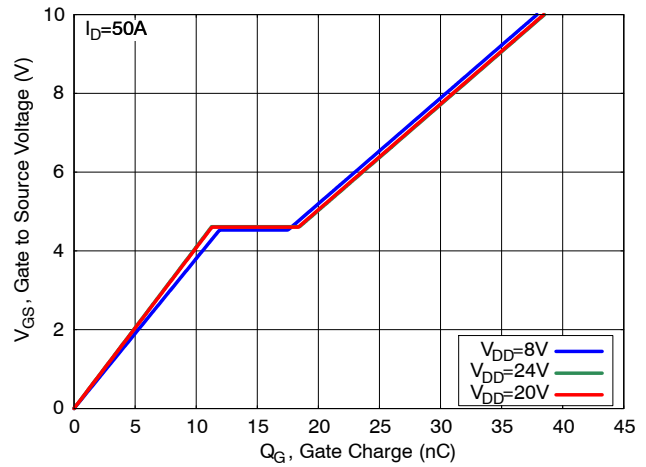


Figure 8. Gate-to-Source Voltage vs. Total Charge

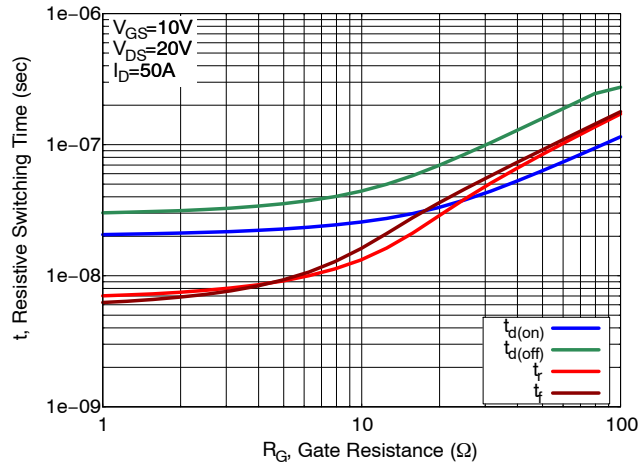


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

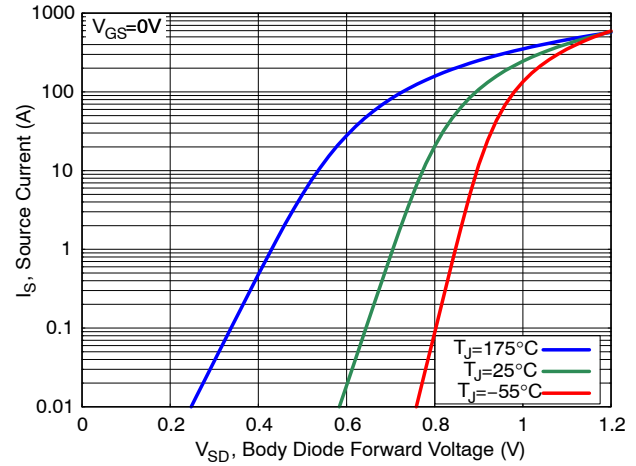


Figure 10. Diode Forward Voltage vs. Current

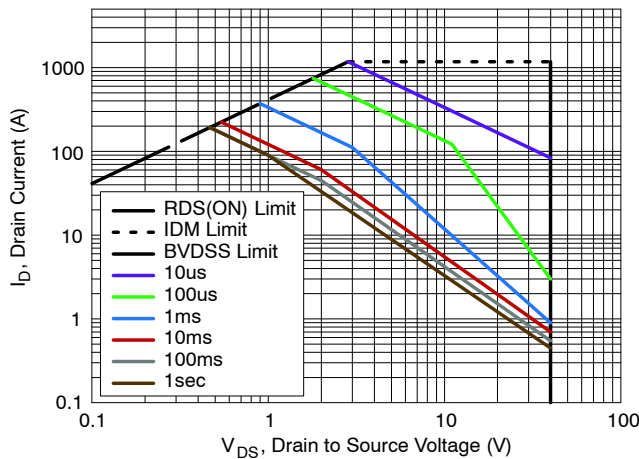


Figure 11. Safe Operating Area (SOA)

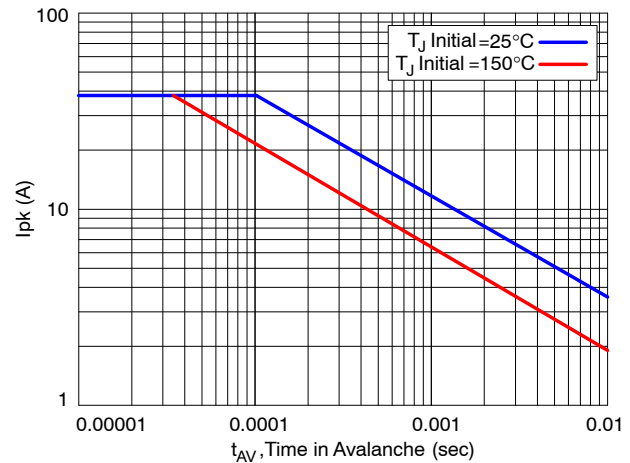


Figure 12. Avalanche Current vs Pulse Time (UIS)

# NTMFS1D3N04XM

## TYPICAL CHARACTERISTICS

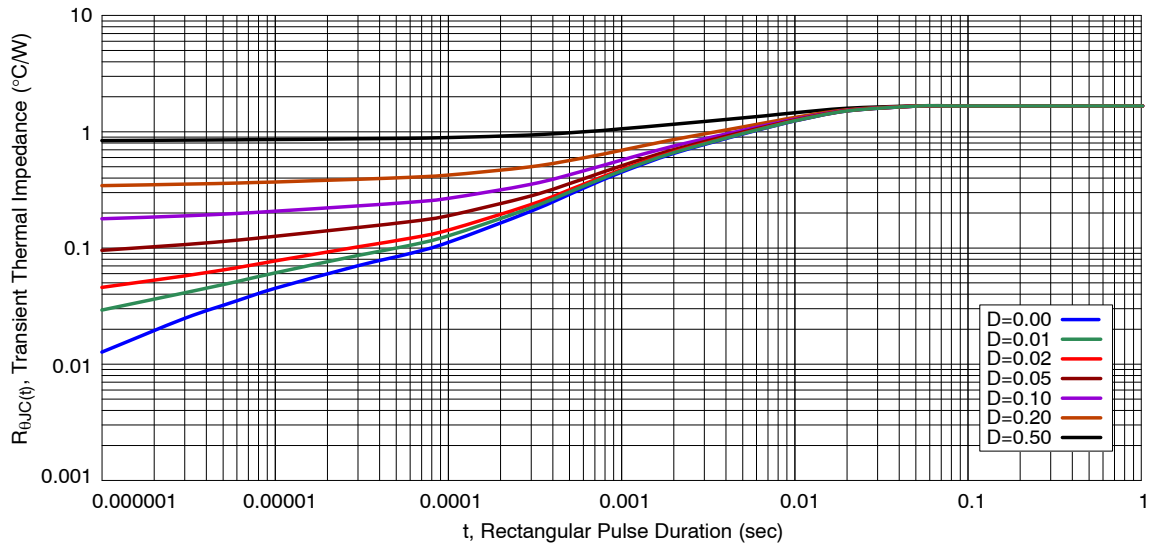


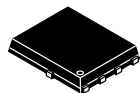
Figure 13. Transient Thermal Response

### ORDERING INFORMATION

| Device           | Marking | Package                    | Shipping <sup>†</sup> |
|------------------|---------|----------------------------|-----------------------|
| NTMFS1D3N04XMT1G | 1D3N4   | SO-8FL (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.

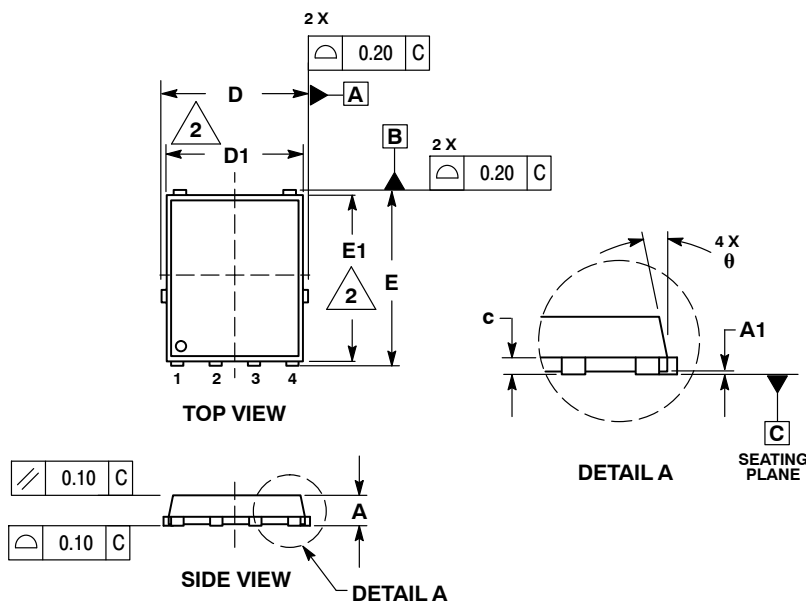
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 2:1

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

DATE 25 JUN 2018

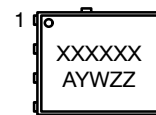


## NOTES:

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.

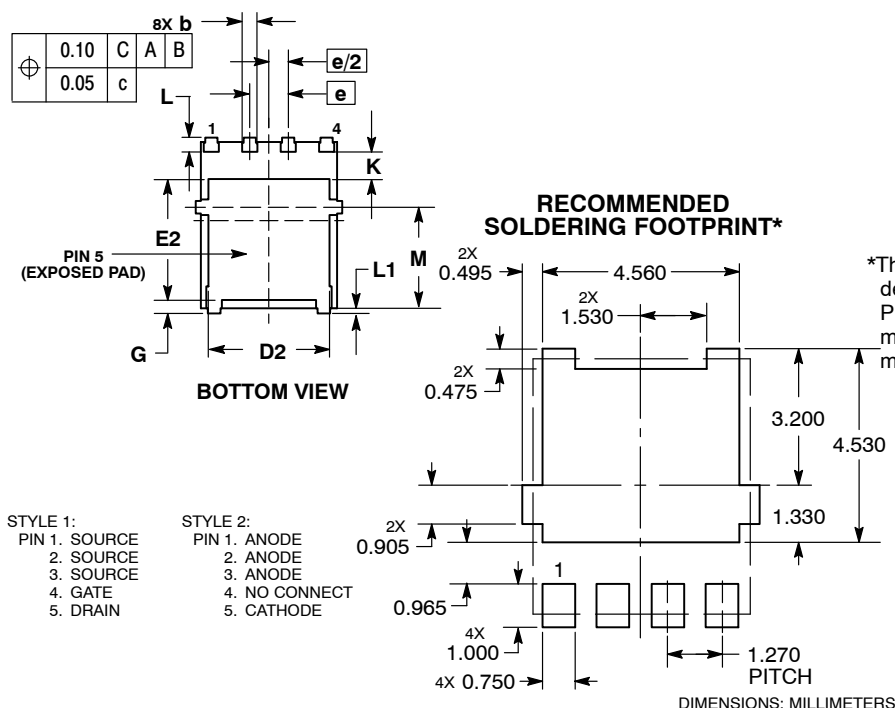
| DIM | MILLIMETERS |       |      |
|-----|-------------|-------|------|
|     | MIN         | NOM   | MAX  |
| A   | 0.90        | 1.00  | 1.10 |
| A1  | 0.00        | ---   | 0.05 |
| b   | 0.33        | 0.41  | 0.51 |
| c   | 0.23        | 0.28  | 0.33 |
| D   | 5.00        | 5.15  | 5.30 |
| D1  | 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 ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

|                         |                                 |                                                                                                                                                                                     |
|-------------------------|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>DFN5 5x6, 1.27P (SO-8FL)</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                                  |

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