

# NTMFS4121N

## Power MOSFET

30 V, 29 A, Single N-Channel,  
SO-8 Flat Lead

### Features

- Low  $R_{DS(on)}$
- Optimized Gate Charge
- Low Inductance SO-8 Package
- These are Pb-Free Devices

### Applications

- Notebooks, Graphics Cards
- DC-DC Converters
- Synchronous Rectification

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

| Parameter  | Symbol                   | Value                    | Unit             |   |
|--|--------------------------|--------------------------|------------------|---|
| Drain-to-Source Voltage  | $V_{DSS}$                | 30                       | V                |   |
| Gate-to-Source Voltage   | $V_{GS}$                 | 20                       | V                |   |
| Continuous Drain Current (Note 1)  | Steady State             | $T_A = 25^\circ\text{C}$ | 17               | A |
|  |                          | $T_A = 85^\circ\text{C}$ | 12               |   |
|  | $t \leq 10$ s            | $T_A = 25^\circ\text{C}$ | 29               |   |
| Power Dissipation (Note 1)   | Steady State             | $T_A = 25^\circ\text{C}$ | 2.2              | W |
|  |                          | $t \leq 10$ s            | 6.6              |   |
| Continuous Drain Current (Note 2)  | Steady State             | $T_A = 25^\circ\text{C}$ | 11               | A |
|  |                          | $T_A = 85^\circ\text{C}$ | 8.0              |   |
|  |                          | $T_A = 25^\circ\text{C}$ | 0.9              | W |
| Power Dissipation (Note 2)   |                          |                          |                  |   |
| Pulsed Drain Current   | $t_p = 10$ $\mu\text{s}$ | $I_{DM}$                 | 88               | A |
| Operating Junction and Storage Temperature   | $T_J, T_{stg}$           | -55 to 150               | $^\circ\text{C}$ |   |
| Source Current (Body Diode)  | $I_S$                    | 6.5                      | A                |   |
| Single Pulse Drain-to-Source Avalanche Energy ( $V_{DD} = 30$ V, $V_{GS} = 10$ V, $I_{PK} = 29$ A, $L = 1$ mH, $R_G = 25$ $\Omega$ ) | $E_{AS}$                 | 430                      | mJ               |   |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s)  | $T_L$                    | 260                      | $^\circ\text{C}$ |   |

### THERMAL RESISTANCE MAXIMUM RATINGS

| Parameter                                    | Symbol          | Value | Unit               |
|--|-----------------|-------|--------------------|
| Junction-to-Case - Steady State              | $R_{\theta JC}$ | 2.2   | $^\circ\text{C/W}$ |
| Junction-to-Ambient - Steady State (Note 1)  | $R_{\theta JA}$ | 56.2  | $^\circ\text{C/W}$ |
| Junction-to-Ambient - $t \leq 10$ s (Note 1) | $R_{\theta JA}$ | 19    |                    |
| Junction-to-Ambient - Steady State (Note 2)  | $R_{\theta JA}$ | 141.1 |                    |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

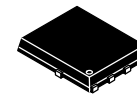
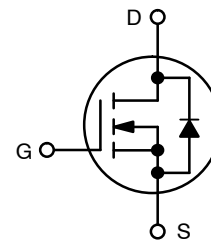
1. Surface mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).
2. Surface mounted on FR4 board using the minimum recommended pad size (Cu area = 1.0 in sq).



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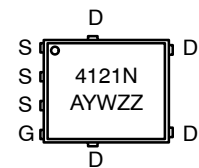
<http://onsemi.com>

| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP       | $I_D$ Max (Note 1) |
|---------------|------------------------|--------------------|
| 30 V          | 4.0 m $\Omega$ @ 10 V  | 29 A               |
|               | 5.5 m $\Omega$ @ 4.5 V |                    |



SO-8 FLAT LEAD  
CASE 488AA  
STYLE 1

### MARKING DIAGRAM



4121N = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
ZZ = Lot Traceability

### ORDERING INFORMATION

| Device        | Package              | Shipping†        |
|---------------|----------------------|------------------|
| NTMFS4121NT1G | SO-8 FL<br>(Pb-Free) | 1500 Tape & Reel |
| NTMFS4121NT3G | SO-8 FL<br>(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.

# NTMFS4121N

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

| Characteristic  | Symbol            | Test Condition                                | Min                       | Typ | Max | Unit          |
|---|-------------------|---|---------------------------|-----|-----|---------------|
| <b>OFF CHARACTERISTICS</b>                                |                   |   |                           |     |     |               |
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$ | 30                        |     |     | V             |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ |   |                           | 21  |     | mV/°C         |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = 24\text{ V}$   | $T_J = 25^\circ\text{C}$  |     | 1.0 | $\mu\text{A}$ |
|   |                   |   | $T_J = 125^\circ\text{C}$ |     | 10  |               |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{DS} = 0\text{ V}, V_{GS} = 20\text{ V}$   |                           |     | 100 | nA            |

## ON CHARACTERISTICS (Note 3)

|  |                  |  |     |     |      |            |
|--|------------------|--|-----|-----|------|------------|
| Gate Threshold Voltage                     | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$  | 1.0 |     | 2.5  | V          |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ |  |     | 7.4 |      | mV/°C      |
| Drain-to-Source On Resistance              | $R_{DS(on)}$     | $V_{GS} = 10\text{ V}, I_D = 24\text{ A}$  |     | 4.2 | 5.25 | m $\Omega$ |
|  |                  | $V_{GS} = 4.5\text{ V}, I_D = 21\text{ A}$ |     | 5.5 | 7.0  |            |
| Forward Transconductance                   | $g_{FS}$         | $V_{DS} = 15\text{ V}, I_D = 24\text{ A}$  |     | 20  |      | S          |

## CHARGES, CAPACITANCES AND GATE RESISTANCE

|                              |              |  |  |      |    |    |
|------------------------------|--------------|--|--|------|----|----|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 24\text{ V}$  |  | 2700 |    | pF |
| Output Capacitance           | $C_{OSS}$    |  |  | 480  |    |    |
| Reverse Transfer Capacitance | $C_{RSS}$    |  |  | 290  |    |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 21\text{ A}$ |  | 24   | 40 | nC |
| Threshold Gate Charge        | $Q_{G(TH)}$  |  |  | 3.0  |    |    |
| Gate-to-Source Charge        | $Q_{GS}$     |  |  | 7.3  |    |    |
| Gate-to-Drain Charge         | $Q_{GD}$     |  |  | 10.2 |    |    |
| Gate Resistance              | $R_G$        |  |  | 1.5  |    |    |

## SWITCHING CHARACTERISTICS, $V_{GS} = 4.5\text{ V}$ (Note 4)

|                     |              |  |  |    |  |    |
|---------------------|--------------|--|--|----|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 1.0\text{ A}, R_L = 15\ \Omega, R_G = 3.0\ \Omega$ |  | 16 |  | ns |
| Rise Time           | $t_r$        |  |  | 29 |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |  |  | 32 |  |    |
| Fall Time           | $t_f$        |  |  | 31 |  |    |

## DRAIN-SOURCE DIODE CHARACTERISTICS

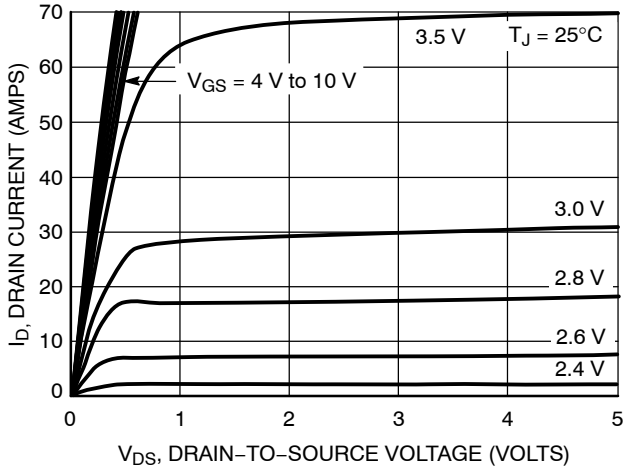
|                         |          |   |                           |      |     |     |    |
|-------------------------|----------|---|---------------------------|------|-----|-----|----|
| Forward Diode Voltage   | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = 6.0\text{ A}$                                     | $T_J = 25^\circ\text{C}$  |      | 0.8 | 1.0 | V  |
|                         |          |   | $T_J = 125^\circ\text{C}$ |      | 0.6 |     |    |
| Reverse Recovery Time   | $t_{RR}$ | $V_{GS} = 0\text{ V}, di_S/dt = 100\text{ A}/\mu\text{s}, I_S = 6.0\text{ A}$ |                           | 34   |     | ns  |    |
| Charge Time             | $t_a$    |   |                           | 18   |     |     |    |
| Discharge Time          | $t_b$    |   |                           | 16   |     |     |    |
| Reverse Recovery Charge | $Q_{RR}$ |   |                           | 25.4 |     |     | nC |

3. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

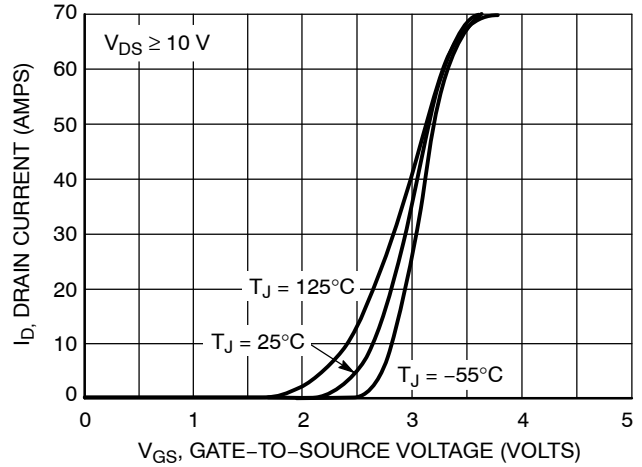
4. Switching characteristics are independent of operating junction temperatures.

# NTMFS4121N

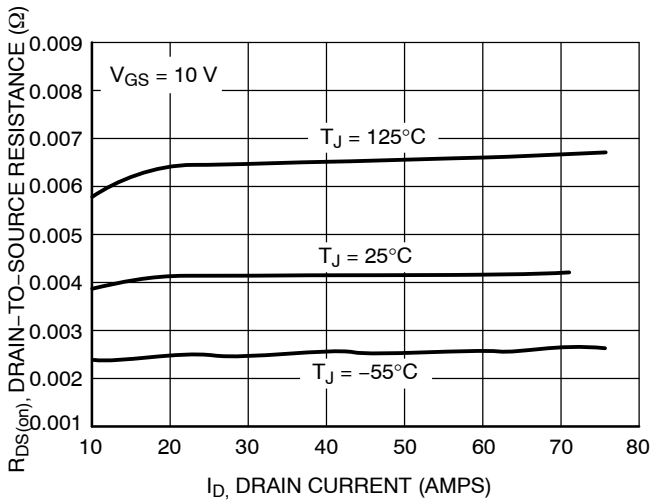
## TYPICAL PERFORMANCE CURVES



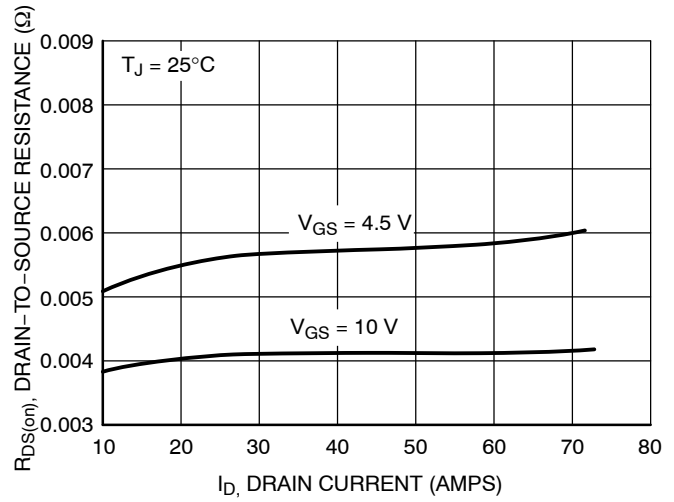
**Figure 1. On-Region Characteristics**



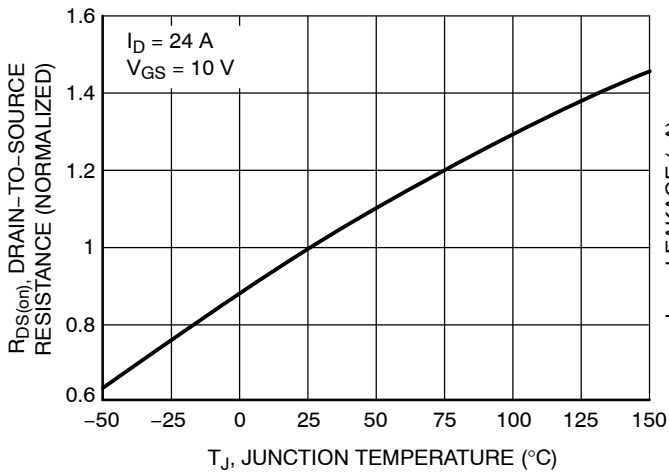
**Figure 2. Transfer Characteristics**



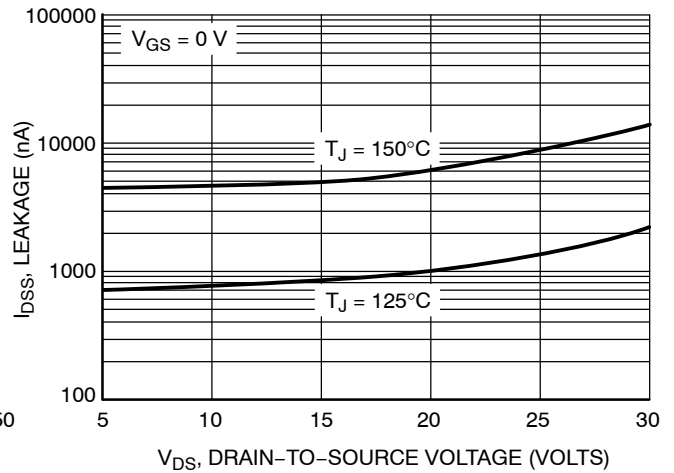
**Figure 3. On-Resistance vs. Drain Current and Temperature**



**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**

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## TYPICAL PERFORMANCE CURVES

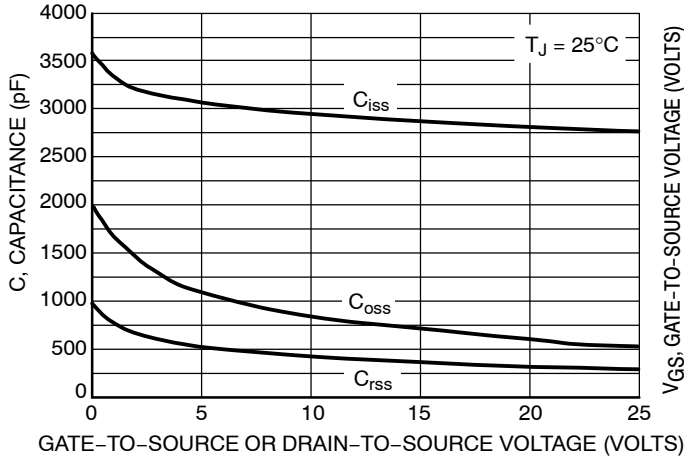


Figure 7. Capacitance Variation

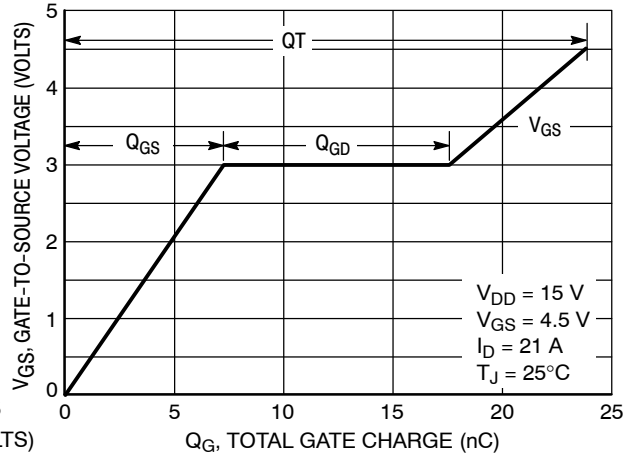


Figure 8. Gate-To-Source and Drain-To-Source Voltage vs. Total Charge

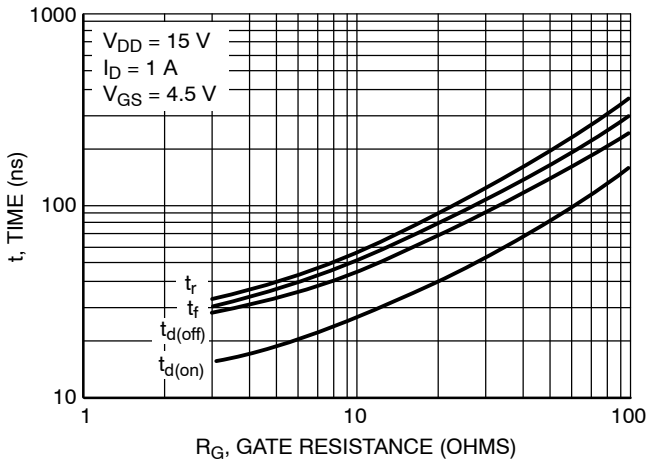


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

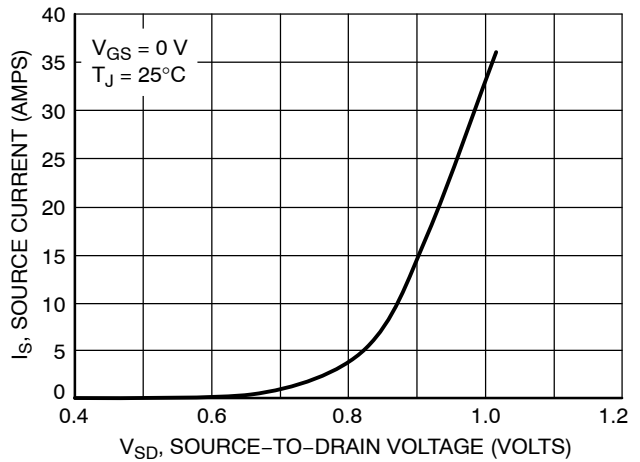


Figure 10. Diode Forward Voltage vs. Current

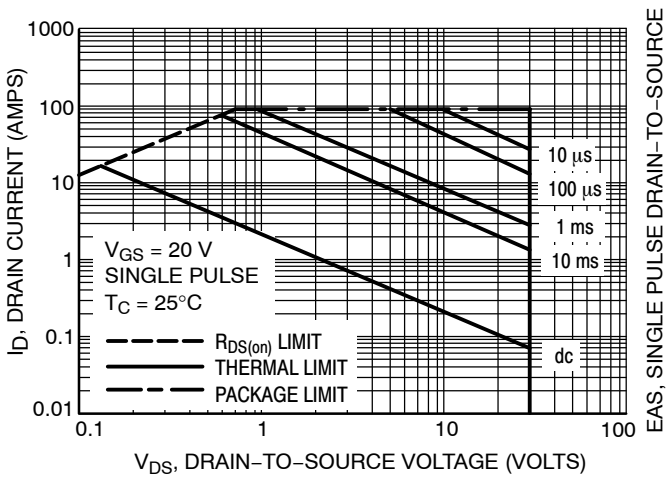


Figure 11. Maximum Rated Forward Biased Safe Operating Area

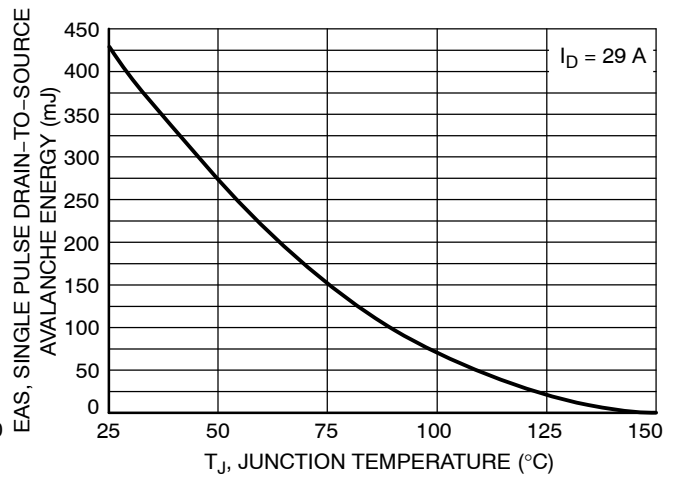


Figure 12. Maximum Avalanche Energy vs Starting Junction Temperature

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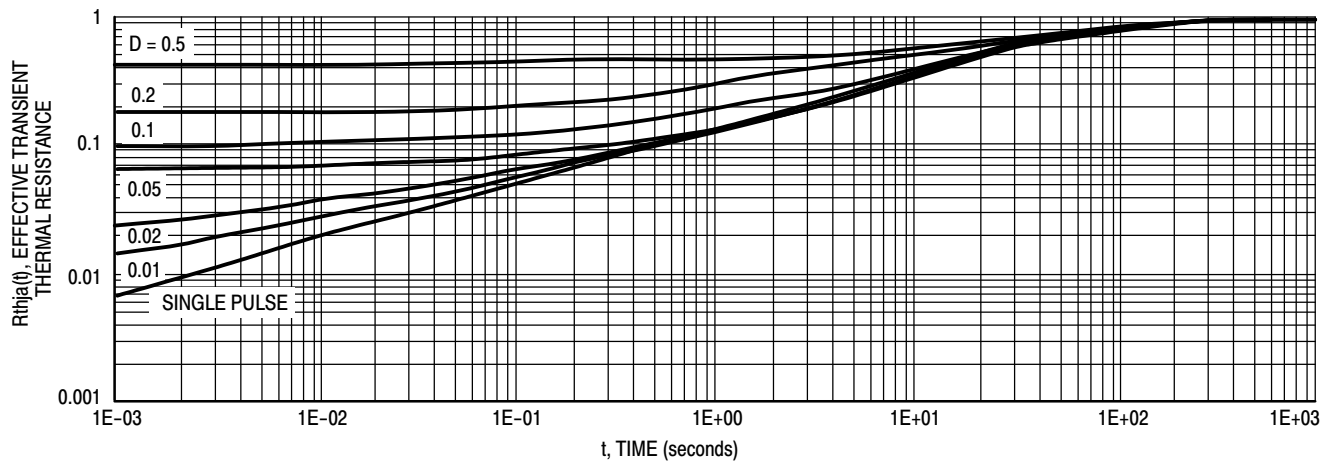
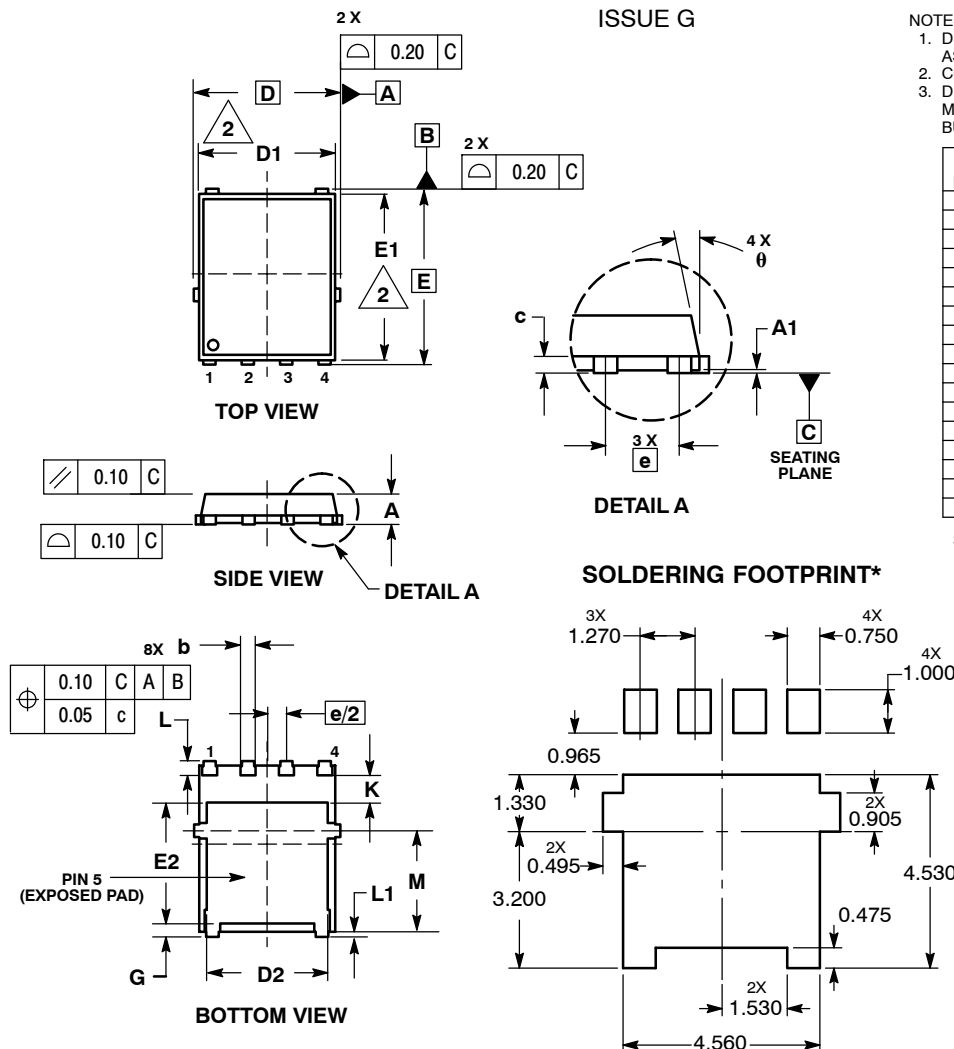


Figure 13. Thermal Response

# NTMFS4121N

## PACKAGE DIMENSIONS

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



- 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   | 5.15 BSC    |      |      |
| D1  | 4.50        | 4.90 | 5.10 |
| D2  | 3.50        | ---  | 4.22 |
| E   | 6.15 BSC    |      |      |
| E1  | 5.50        | 5.80 | 6.10 |
| E2  | 3.45        | ---  | 4.30 |
| e   | 1.27 BSC    |      |      |
| G   | 0.51        | 0.61 | 0.71 |
| K   | 1.20        | 1.35 | 1.50 |
| L   | 0.51        | 0.61 | 0.71 |
| L1  | 0.05        | 0.17 | 0.20 |
| M   | 3.00        | 3.40 | 3.80 |
| θ   | 0°          | ---  | 12°  |

- STYLE 1:  
PIN 1. SOURCE  
2. SOURCE  
3. SOURCE  
4. GATE  
5. DRAIN

\*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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