# NTMFS4C028N

# Power MOSFET

## 30 V, 52 A, Single N−Channel, SO−8 FL

### Features

- Low $R_{DS(on)}$ to Minimize Conduction Losses
- Low Capacitance to Minimize Driver Losses
- Optimized Gate Charge to Minimize Switching Losses
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

- CPU Power Delivery
- DC−DC Converters

**MAXIMUM RATINGS** ($T_J$ = 25°C unless otherwise stated)

| Parameter | | | Symbol | Value | Unit |
|---|---|---|---|---|---|
| Drain−to−Source Voltage | | | $V_{DSS}$ | 30 | V |
| Gate−to−Source Voltage | | | $V_{GS}$ | ±20 | V |
| Continuous Drain Current $R_{\theta JA}$ (Note 1) | Steady State | $T_A$ = 25°C | $I_D$ | 16.4 | A |
| | | $T_A$ = 80°C | | 12.3 | |
| Power Dissipation $R_{\theta JA}$ (Note 1) | | $T_A$ = 25°C | $P_D$ | 2.51 | W |
| Continuous Drain Current $R_{\theta JA}$ ≤ 10 s (Note 1) | | $T_A$ = 25°C | $I_D$ | 25.3 | A |
| | | $T_A$ = 80°C | | 19.0 | |
| Power Dissipation $R_{\theta JA}$ ≤ 10 s (Note 1) | | $T_A$ = 25°C | $P_D$ | 6.0 | W |
| Continuous Drain Current $R_{\theta JA}$ (Note 2) | | $T_A$ = 25°C | $I_D$ | 9.0 | A |
| | | $T_A$ = 80°C | | 6.8 | |
| Power Dissipation $R_{\theta JA}$ (Note 2) | | $T_A$ = 25°C | $P_D$ | 0.76 | W |
| Continuous Drain Current $R_{\theta JC}$ (Note 1) | | $T_C$ = 25°C | $I_D$ | 52 | A |
| | | $T_C$ =80°C | | 39 | |
| Power Dissipation $R_{\theta JC}$ (Note 1) | | $T_C$ = 25°C | $P_D$ | 25.5 | W |
| Pulsed Drain Current | $T_A$ = 25°C, $t_p$ = 10 μs | | $I_{DM}$ | 146 | A |
| Current Limited by Package | | $T_A$ = 25°C | $I_{Dmax}$ | 80 | A |
| Operating Junction and Storage Temperature | | | $T_J$, $T_{STG}$ | −55 to +150 | °C |
| Source Current (Body Diode) | | | $I_S$ | 23 | A |
| Drain to Source dV/dt | | | $dV/d_t$ | 7.0 | V/ns |
| Single Pulse Drain−to−Source Avalanche Energy ($T_J$ = 25°C, $V_{GS}$ = 10 V, $I_L$ = 29 $A_{pk}$, L = 0.1 mH, $R_{GS}$ = 25 Ω) (Note 3) | | | $E_{AS}$ | 42 | mJ |
| Lead Temperature for Soldering Purposes (1/8″ from case for 10 s) | | | $T_L$ | 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 sq−in pad, 1 oz Cu.
2. Surface−mounted on FR4 board using the minimum recommended pad size.
3. Parts are 100% tested at $T_J$ = 25°C, $V_{GS}$ = 10 V, $I_L$ = 20 $A_{pk}$, EAS = 20 mJ.

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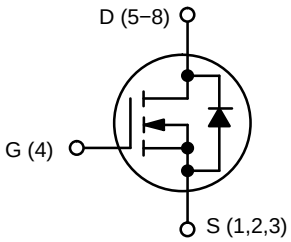
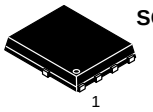
| $V_{(BR)DSS}$ | $R_{DS(ON)}$ MAX | $I_D$ MAX |
|---|---|---|
| 30 V | 4.73 mΩ @ 10 V | 52 A |
| | 7.0 mΩ @ 4.5 V | |

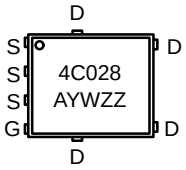



**N−CHANNEL MOSFET**

**MARKING DIAGRAMS**



**SO−8 FLAT LEAD CASE 488AA STYLE 1**




A = Assembly Location
Y = Year
W = Work Week
ZZ = Lot Traceabililty

**ORDERING INFORMATION**

| Device | Package | Shipping† |
|---|---|---|
| NTMFS4C028NT1G | SO−8 FL (Pb−Free) | 1500 / Tape & Reel |
| NTMFS4C028NT3G | SO−8 FL (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 Specifications Brochure, BRD8011/D.

## THERMAL RESISTANCE MAXIMUM RATINGS

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Junction−to−Case (Drain) | $R_{\theta JC}$ | 4.9 | °C/W |
| Junction−to−Ambient – Steady State (Note 4) | $R_{\theta JA}$ | 49.8 | |
| Junction−to−Ambient – Steady State (Note 5) | $R_{\theta JA}$ | 164.6 | |
| Junction−to−Ambient – (t ≤ 10 s) (Note 4) | $R_{\theta JA}$ | 21.0 | |

4. Surface−mounted on FR4 board using 1 sq−in pad, 1 oz Cu.
5. Surface−mounted on FR4 board using the minimum recommended pad size.

## ELECTRICAL CHARACTERISTICS ($T_J$ = 25°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 V, $I_D$ = 250 μA | | 30 | | | V |
| Drain−to−Source Breakdown Voltage (transient) | $V_{(BR)DSSt}$ | $V_{GS}$ = 0 V, $I_{D(aval)}$ = 8.4 A, $T_{case}$ = 25°C, $t_{transient}$ = 100 ns | | 34 | | | V |
| Drain−to−Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}$/$T_J$ | | | | 14.4 | | mV/°C |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 24 V | $T_J$ = 25°C | | | 1.0 | μA |
| | | | $T_J$ = 125°C | | | 10 | |
| Gate−to−Source Leakage Current | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ±20 V | | | | ±100 | nA |
| **ON CHARACTERISTICS** (Note 6) | | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | | 1.3 | | 2.1 | V |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}$/$T_J$ | | | | 4.8 | | mV/°C |
| Drain−to−Source On Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 30 A | | 3.9 | 4.73 | mΩ |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 18 A | | 5.8 | 7.0 | |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$ = 1.5 V, $I_D$ = 15 A | | | 50 | | S |
| Gate Resistance | $R_G$ | $T_A$ = 25°C | | 0.3 | 1.0 | 2.0 | Ω |
| **CHARGES AND CAPACITANCES** | | | | | | | |
| Input Capacitance | $C_{ISS}$ | $V_{GS}$ = 0 V, f = 1 MHz, $V_{DS}$ = 15 V | | | 1252 | | pF |
| Output Capacitance | $C_{OSS}$ | | | | 610 | | |
| Reverse Transfer Capacitance | $C_{RSS}$ | | | | 126 | | |
| Capacitance Ratio | $C_{RSS}$/$C_{ISS}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 15 V, f = 1 MHz | | | 0.101 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = 4.5 V, $V_{DS}$ = 15 V; $I_D$ = 30 A | | | 10.9 | | nC |
| Threshold Gate Charge | $Q_{G(TH)}$ | | | | 1.9 | | |
| Gate−to−Source Charge | $Q_{GS}$ | | | | 3.4 | | |
| Gate−to−Drain Charge | $Q_{GD}$ | | | | 5.4 | | |
| Gate Plateau Voltage | $V_{GP}$ | | | | 3.1 | | V |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = 10 V, $V_{DS}$ = 15 V; $I_D$ = 30 A | | | 22.2 | | nC |
| **SWITCHING CHARACTERISTICS** (Note 7) | | | | | | | |
| Turn−On Delay Time | $t_{d(ON)}$ | $V_{GS}$ = 4.5 V, $V_{DS}$ = 15 V, $I_D$ = 15 A, $R_G$ = 3.0 Ω | | | 10 | | ns |
| Rise Time | $t_r$ | | | | 32 | | |
| Turn−Off Delay Time | $t_{d(OFF)}$ | | | | 16 | | |
| Fall Time | $t_f$ | | | | 6.0 | | |

6. Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%.
7. Switching characteristics are independent of operating junction temperatures.

**ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise specified)

| Parameter | Symbol | Test Condition | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **SWITCHING CHARACTERISTICS** (Note 7) | | | | | | | |
| Turn−On Delay Time | $t_{d(ON)}$ | $V_{GS}$ = 10 V, $V_{DS}$ = 15 V, $I_D$ = 15 A, $R_G$ = 3.0 Ω | | | 7.0 | | ns |
| Rise Time | $t_r$ | | | | 28 | | |
| Turn−Off Delay Time | $t_{d(OFF)}$ | | | | 20 | | |
| Fall Time | $t_f$ | | | | 4.0 | | |
| **DRAIN−SOURCE DIODE CHARACTERISTICS** | | | | | | | |
| Forward Diode Voltage | $V_{SD}$ | $V_{GS}$ = 0 V, $I_S$ = 10 A | $T_J$ = 25°C | | 0.79 | 1.1 | V |
| | | | $T_J$ = 125°C | | 0.65 | | |
| Reverse Recovery Time | $t_{RR}$ | $V_{GS}$ = 0 V, dIS/dt = 100 A/μs, $I_S$ = 30 A | | | 31 | | ns |
| Charge Time | $t_a$ | | | | 15 | | |
| Discharge Time | $t_b$ | | | | 16 | | |
| Reverse Recovery Charge | $Q_{RR}$ | | | | 15 | | nC |

6. Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%.
7. Switching characteristics are independent of operating junction temperatures.

## TYPICAL CHARACTERISTICS

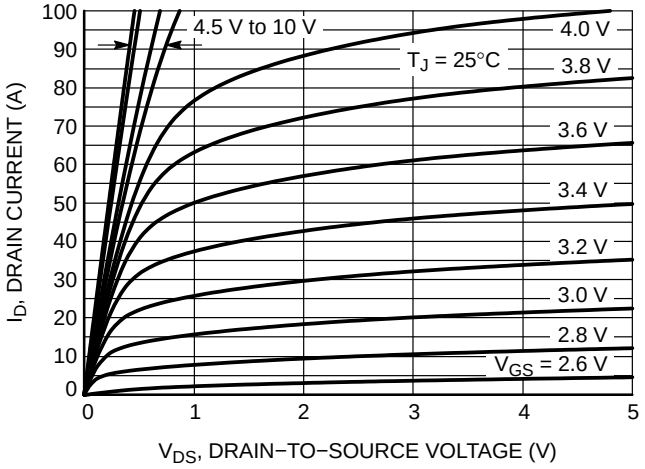



**Figure 1. On−Region Characteristics**

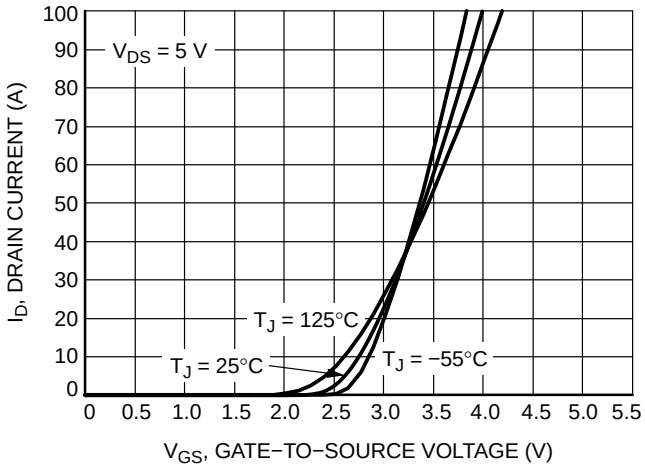



**Figure 2. Transfer Characteristics**

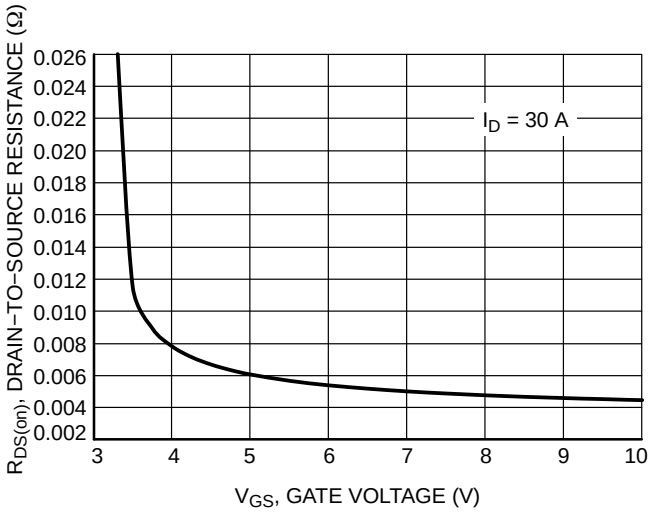



**Figure 3. On−Resistance vs. Gate−to−Source Voltage**

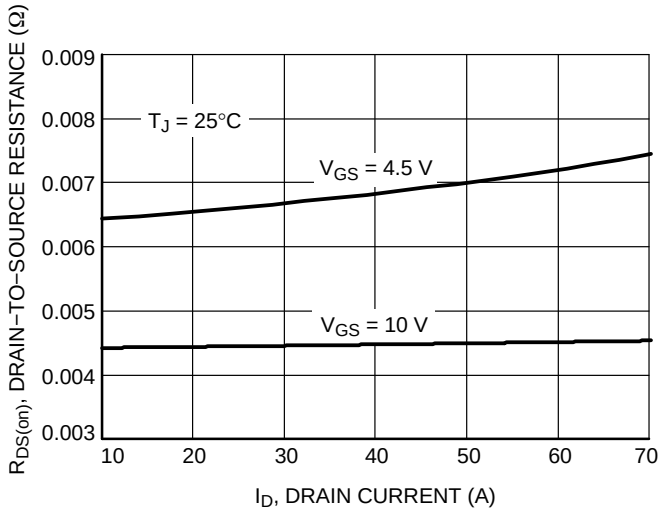



**Figure 4. On−Resistance vs. Drain Current and Gate Voltage**

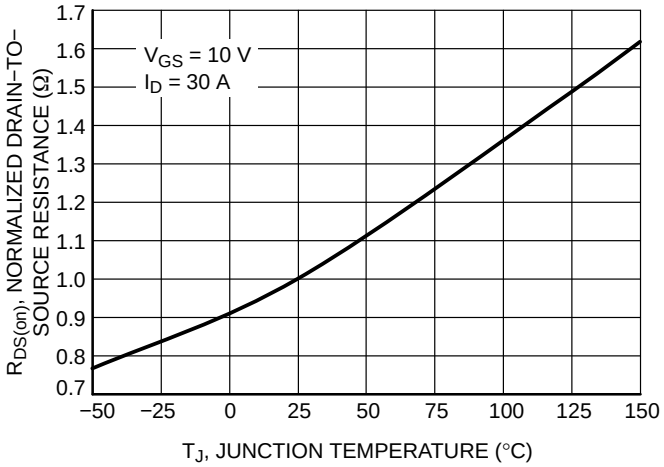



**Figure 5. On−Resistance Variation with Temperature**

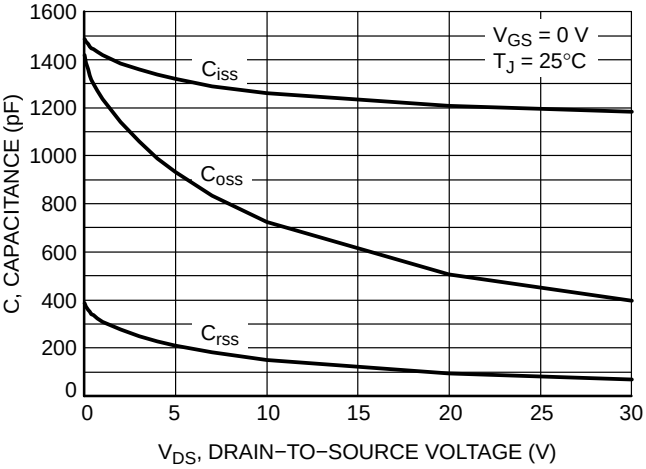



**Figure 6. Capacitance Variation**

## TYPICAL CHARACTERISTICS

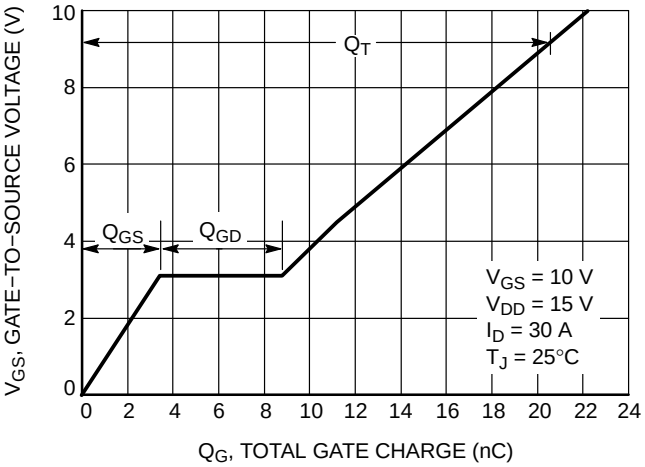



**Figure 7. Gate−to−Source and Drain−to−Source Voltage vs. Total Charge**

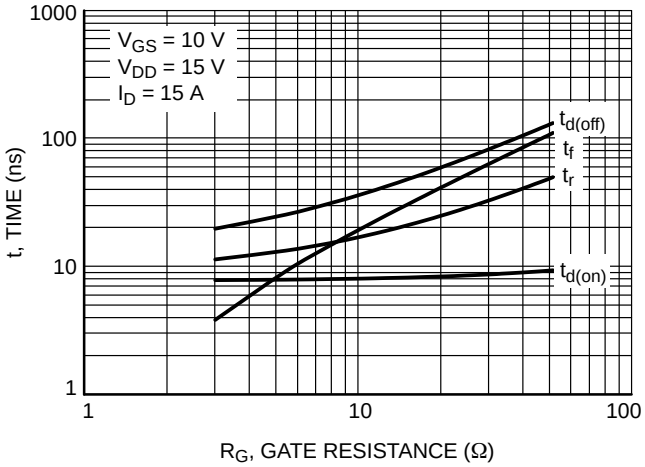



**Figure 8. Resistive Switching Time Variation vs. Gate Resistance**

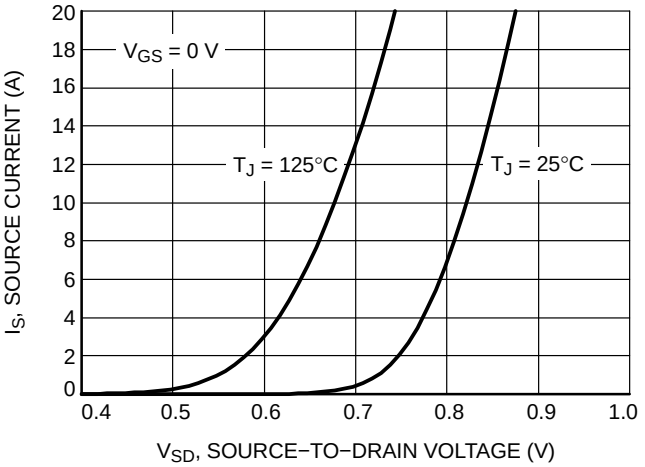



**Figure 9. Diode Forward Voltage vs. Current**

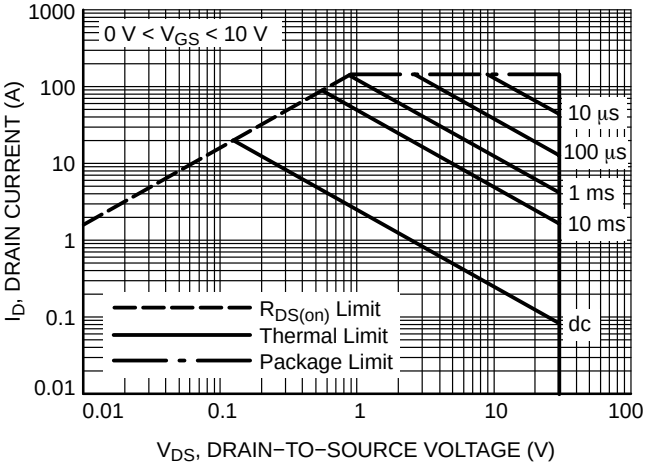



**Figure 10. Maximum Rated Forward Biased Safe Operating Area**

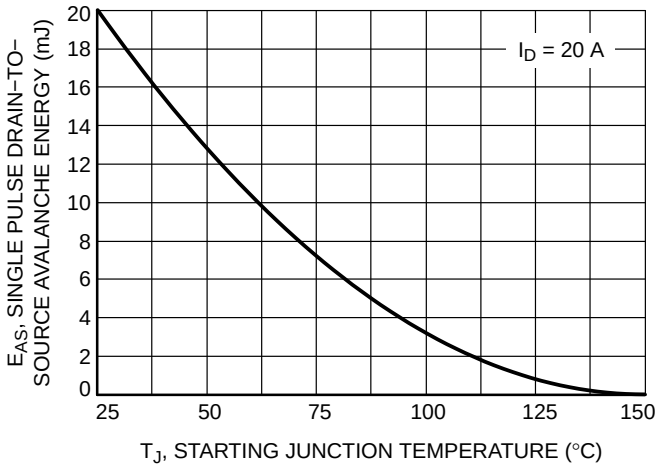



**Figure 11. Maximum Avalanche Energy vs. Starting Junction Temperature**

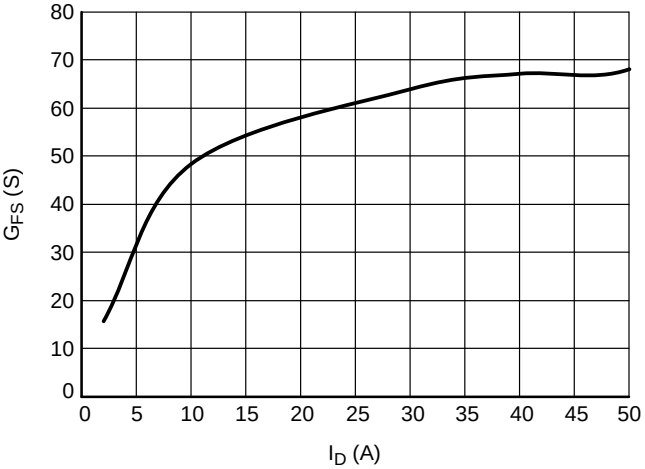



**Figure 12. $G_{FS}$ vs. $I_D$**

## TYPICAL CHARACTERISTICS

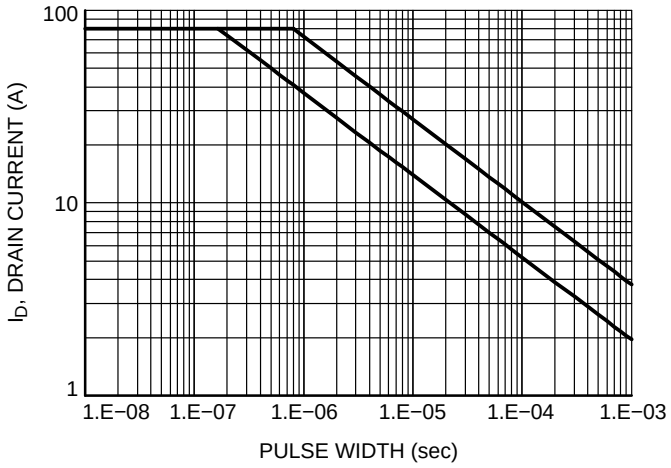



**Figure 13. Avalanche Characteristics**

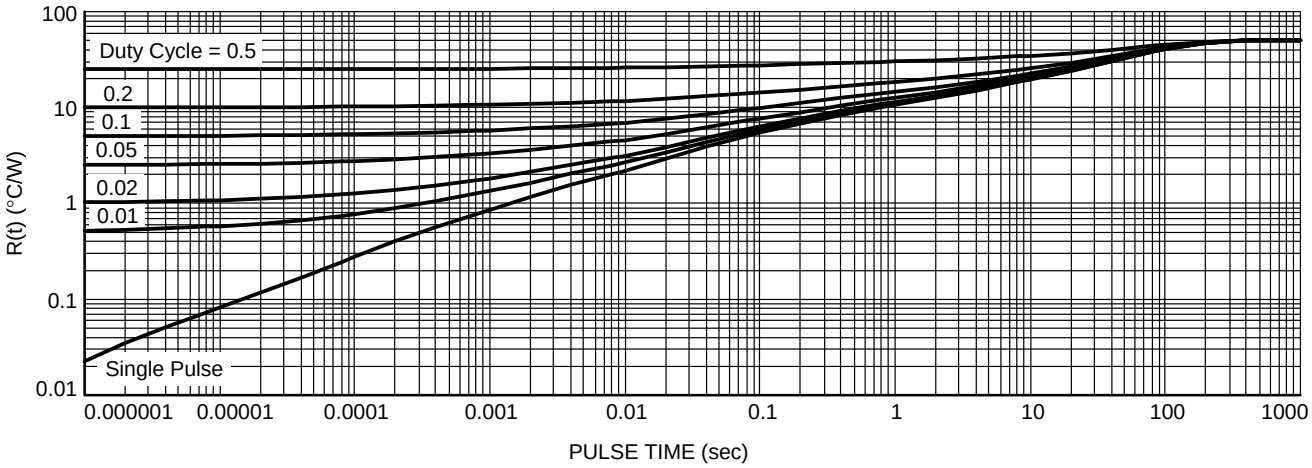
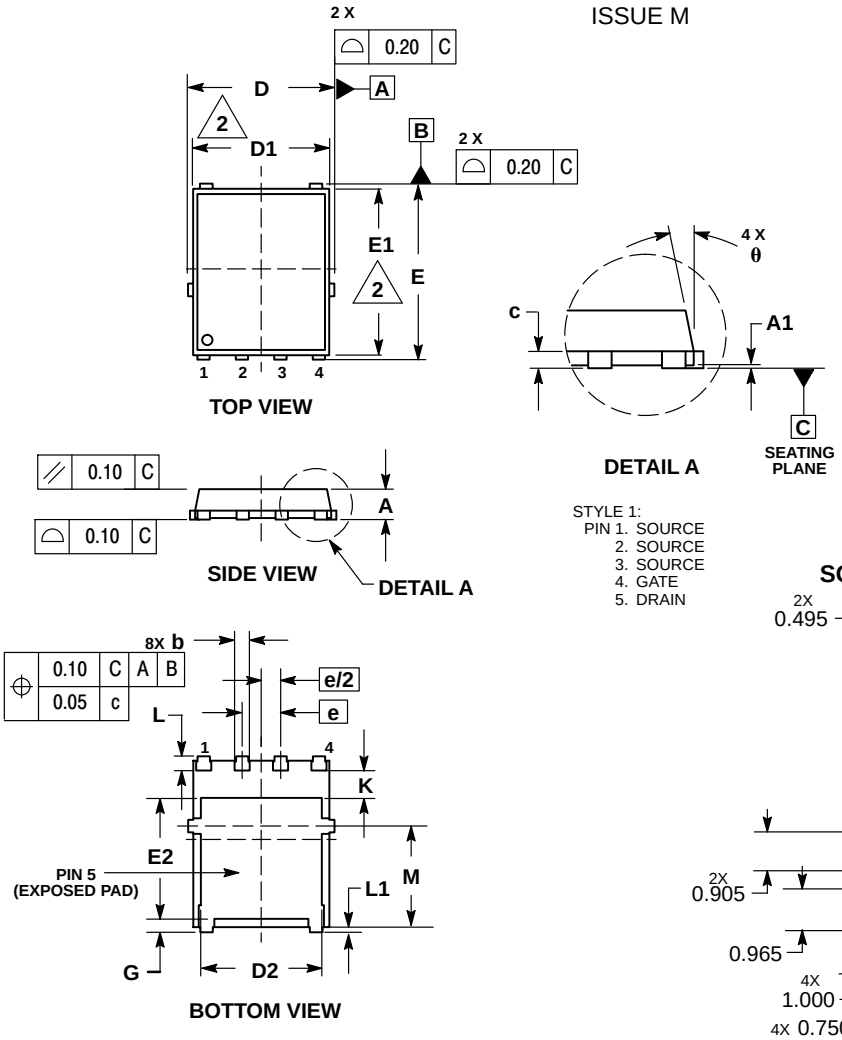



**Figure 14. Thermal Response**

## PACKAGE DIMENSIONS

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

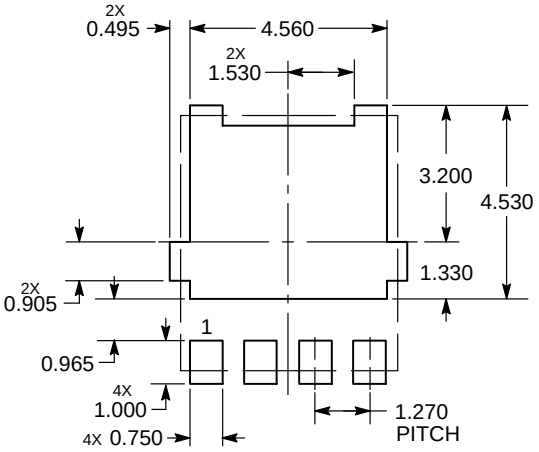



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION D1 AND E1 DO NOT INCLUDE MOLD FLASH PROTRUSIONS OR GATE BURRS.

| | 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 | 4.70 | 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 ° |

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

### RECOMMENDED SOLDERING FOOTPRINT*




DIMENSIONS: MILLIMETERS

*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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