# NTMFS4H02NF

# MOSFET – Power, Single, N-Channel, SO-8FL
## 25 V, 193 A

### Features
- Integrated Schottky Diode
- Optimized Design to Minimize Conduction and Switching Losses
- Optimized Package to Minimize Parasitic Inductances
- Optimized material for improved thermal performance
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications
- High Performance DC-DC Converters
- System Voltage Rails
- Netcom, Telecom
- Servers & Point of Load

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

| Parameter | Symbol | Value | Units |
|---|---|---|---|
| Drain-to-Source Voltage | $V_{DSS}$ | 25 | V |
| Gate-to-Source Voltage | $V_{GS}$ | ±20 | V |
| Continuous Drain Current $R_{\theta JA}$ ($T_A$ = 25°C, Note 1) | $I_D$ | 37 | A |
| Power Dissipation $R_{\theta JA}$ ($T_A$ = 25°C, Note 1) | $P_D$ | 3.13 | W |
| Continuous Drain Current $R_{\theta JC}$ ($T_C$ = 25°C, Note 1) | $I_D$ | 193 | A |
| Power Dissipation $R_{\theta JC}$ ($T_C$ = 25°C, Note 1) | $P_D$ | 83 | W |
| Pulsed Drain Current ($t_p$ = 10 μs) | $I_{DM}$ | 449 | A |
| Single Pulse Drain-to-Source Avalanche Energy (Note 1) ($I_L$ = 38 $A_{pk}$, L = 0.3 mH) | $E_{AS}$ | 223 | mJ |
| Drain to Source dV/dt | dV/dt | 7 | V/ns |
| Maximum Junction Temperature | $T_{J(max)}$ | 150 | °C |
| Storage Temperature Range | $T_{STG}$ | −55 to 150 | °C |
| Lead Temperature Soldering Reflow (SMD Styles Only), Pb-Free Versions (Note 2) | $T_{SLD}$ | 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. Values based on copper area of 645 $mm^2$ (or 1 $in^2$) of 2 oz copper thickness and FR4 PCB substrate.
2. For more information, please refer to our Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.
3. This is the absolute maximum rating. Parts are 100% UIS tested at $T_J$ = 25°C, $V_{GS}$ = 10 V, $I_L$ = 26 A, $E_{AS}$ = 101 mJ.

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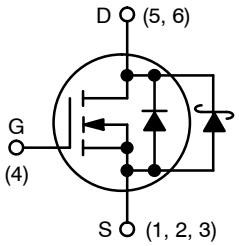
| $V_{GS}$ | MAX $R_{DS(on)}$ | TYP $Q_{GTOT}$ |
|---|---|---|
| 4.5 V | 2.3 mΩ | 17.4 nC |
| 10 V | 1.4 mΩ | 39.3 nC |

**PIN CONNECTIONS**

SO8−FL (5 x 6 mm)


(Top View) (Bottom View)

**N−CHANNEL MOSFET**




**ORDERING INFORMATION**

See detailed ordering, marking and shipping information on page 7 of this data sheet.

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**THERMALCHARACTERISTICS**

| Parameter | Symbol | Max | Units |
|---|---|---|---|
| Thermal Resistance,<br>Junction-to-Ambient (Note 1 and 4)<br>Junction-to-Case (Note 1 and 4) | <br>$R_{\theta JA}$<br>$R_{\theta JC}$ | <br>40.0<br>1.5 | °C/W |

4. Thermal Resistance $R_{\theta JA}$ and $R_{\theta JC}$ as defined in JESD51−3.

**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 | | 25 | | | V |
| Drain−to−Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | | | | 18.6 | | mV/°C |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 20 V | $T_J$ = 25°C | | | 500 | μA |
| Gate−to−Source Leakage Current | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = +20 V | | | | +100 | nA |
| **ON CHARACTERISTICS** (Note 5) | | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | | 1.2 | | 2.1 | V |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ | | | | 3.3 | | mV/°C |
| Drain−to−Source On Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 30 A | | 1.1 | 1.4 | mΩ |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 30 A | | 1.6 | 2.3 | |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$ = 12 V, $I_D$ = 15 A | | | 84 | | S |
| **CHARGES, CAPACITANCES & GATE RESISTANCE** | | | | | | | |
| Input Capacitance | $C_{ISS}$ | $V_{GS}$ = 0 V, f = 1 MHz, $V_{DS}$ = 12 V | | | 2652 | | pF |
| Output Capacitance | $C_{OSS}$ | | | | 1644 | | |
| Reverse Transfer Capacitance | $C_{RSS}$ | | | | 94 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = 4.5 V, $V_{DS}$ = 12 V; $I_D$ = 30 A | | | 18.7 | | nC |
| Threshold Gate Charge | $Q_{G(TH)}$ | | | | 2.8 | | |
| Gate−to−Source Charge | $Q_{GS}$ | | | | 7.5 | | |
| Gate−to−Drain Charge | $Q_{GD}$ | | | | 4.3 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = 10 V, $V_{DS}$ = 12 V; $I_D$ = 30 A | | | 40.9 | | nC |
| Gate Resistance | $R_G$ | $T_A$ = 25°C | | | 1.0 | 2 | Ω |
| **SWITCHING CHARACTERISTICS, $V_{GS}$ = 4.5 V** (Note 5) | | | | | | | |
| Turn−On Delay Time | $t_{d(ON)}$ | $V_{GS}$ = 4.5 V, $V_{DD}$ = 12 V, $I_D$ = 15 A, $R_G$ = 3.0 Ω | | | 13.5 | | ns |
| Rise Time | $t_r$ | | | | 46.7 | | |
| Turn−Off Delay Time | $t_{d(OFF)}$ | | | | 24.8 | | |
| Fall Time | $t_f$ | | | | 7.72 | | |
| **SWITCHING CHARACTERISTICS, $V_{GS}$ = 10 V** (Note 5) | | | | | | | |
| Turn−On Delay Time | $t_{d(ON)}$ | $V_{GS}$ = 10 V, $V_{DD}$ = 12 V, $I_D$ = 15 A, $R_G$ = 3.0 Ω | | | 10 | | ns |
| Rise Time | $t_r$ | | | | 35.7 | | |
| Turn−Off Delay Time | $t_{d(OFF)}$ | | | | 32.3 | | |
| Fall Time | $t_f$ | | | | 4.93 | | |
| **DRAIN−SOURCE DIODE CHARACTERISTICS** | | | | | | | |
| Forward Diode Voltage | $V_{SD}$ | $V_{GS}$ = 0 V, $I_S$ = 2.0 A | $T_J$ = 25°C | | 0.38 | 0.6 | V |
| | | | $T_J$ = 125°C | | 0.29 | | |
| Reverse Recovery Time | $t_{RR}$ | $V_{GS}$ = 0 V, dIS/dt = 100 A/μs, $I_S$ = 30 A | | | 41 | | ns |
| Charge Time | $t_a$ | | | | 20.2 | | |
| Discharge Time | $t_b$ | | | | 20.8 | | |
| Reverse Recovery Charge | $Q_{RR}$ | | | | 30 | | 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.

5. Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%.
6. 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 |
|---|---|---|---|---|---|---|
| **PACKAGE PARASITIC VALUES** | | | | | | |
| Source Inductance | $L_S$ | $T_A$ = 25°C | | 0.57 | | nH |
| Drain Inductance | $L_D$ | | | 0.13 | | nH |
| Gate Inductance | $L_G$ | | | 1.37 | | nH |

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.

5. Pulse Test: pulse width $\leq$ 300 μs, duty cycle $\leq$ 2%.
6. Switching characteristics are independent of operating junction temperatures.

## TYPICAL CHARACTERISTICS

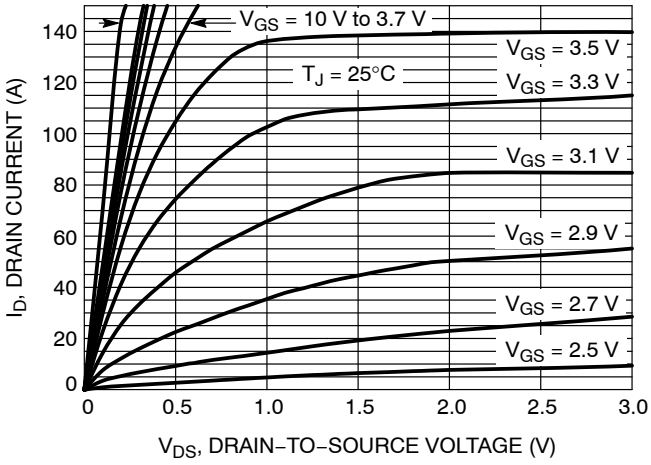



**Figure 1. On−Region Characteristics**

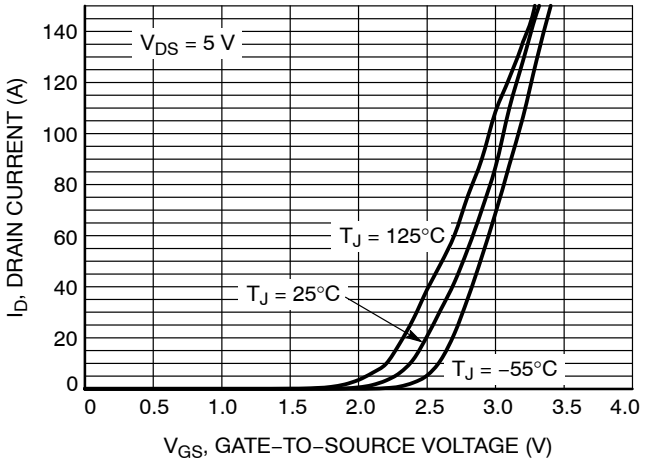



**Figure 2. Transfer Characteristics**

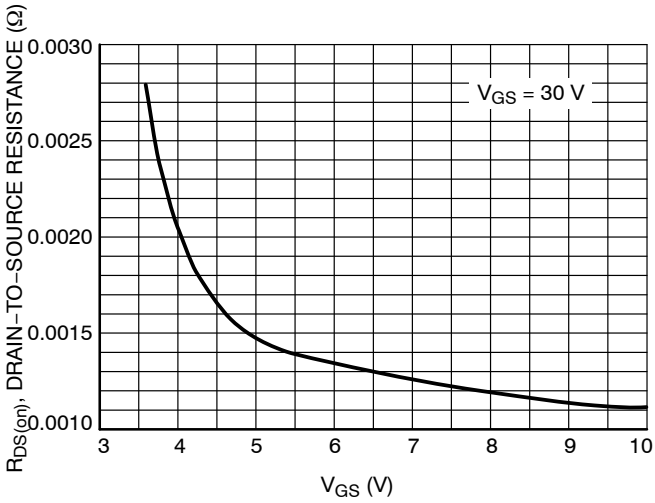



**Figure 3. On−Resistance vs. $V_{GS}$**

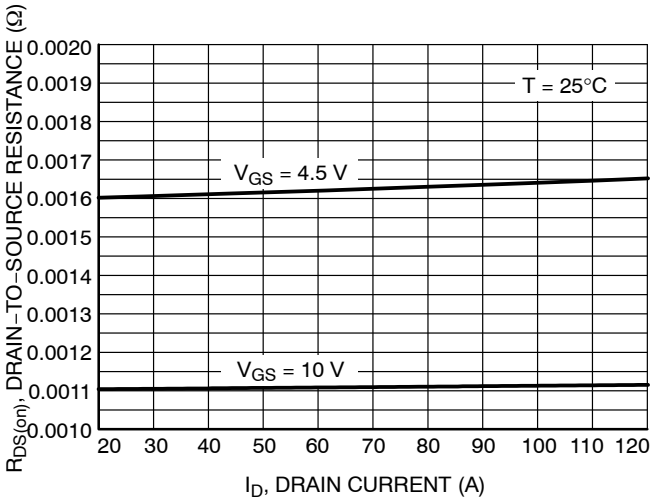



**Figure 4. On−Resistance vs. Drain Current and Gate Voltage**

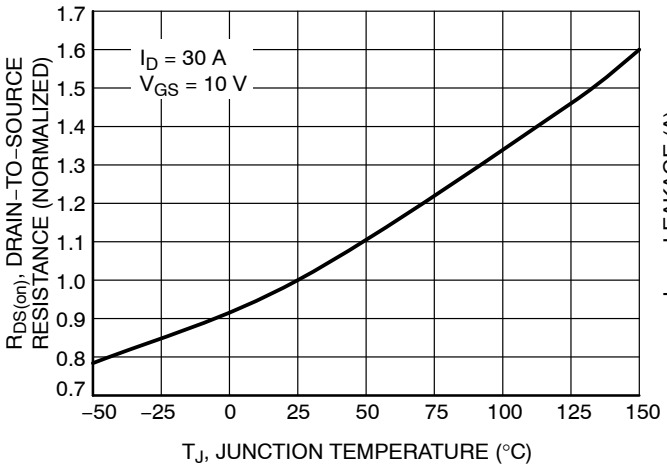



**Figure 5. On−Resistance Variation with Temperature**

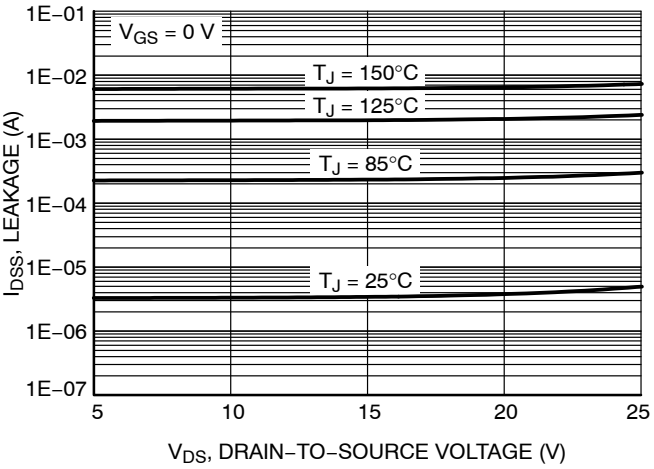



**Figure 6. Drain−to−Source Leakage Current vs. Voltage**

## TYPICAL CHARACTERISTICS

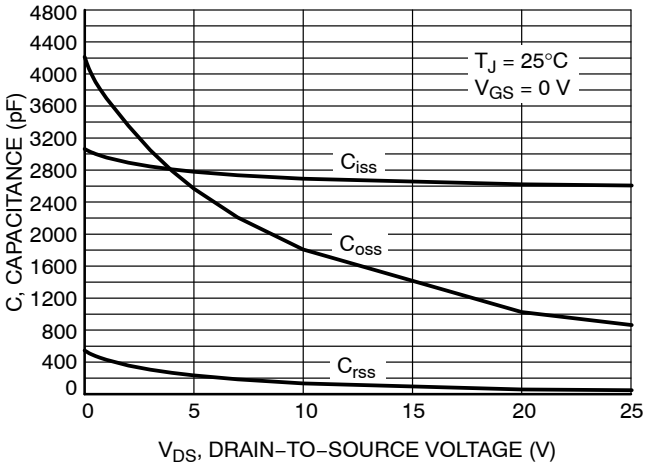



**Figure 7. Capacitance Variation**

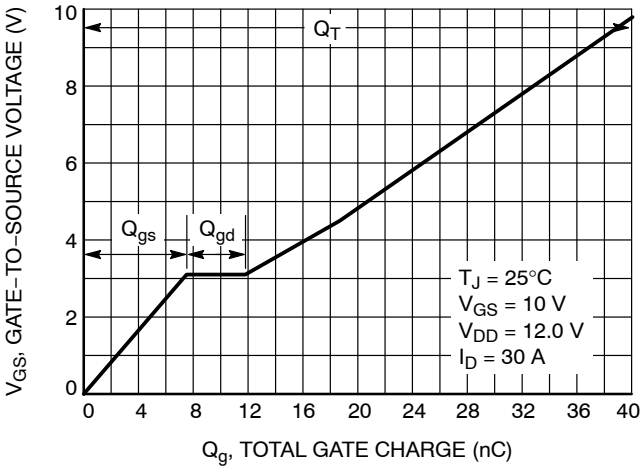



**Figure 8. Gate−to−Source and Drain−to−Source Voltage vs. Total Charge**

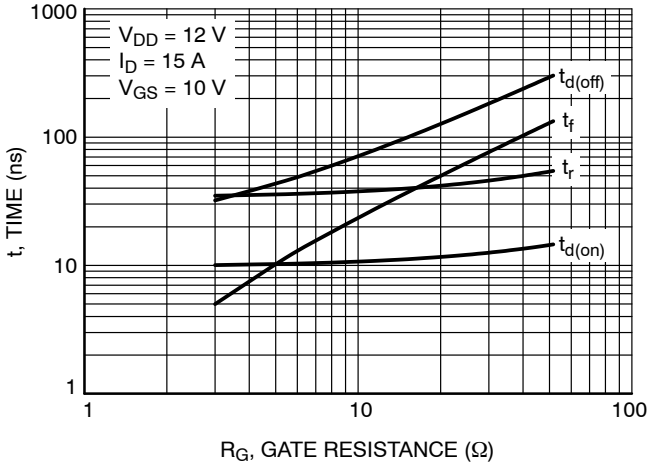



**Figure 9. Resistive Switching Time Variation vs. Gate Resistance**

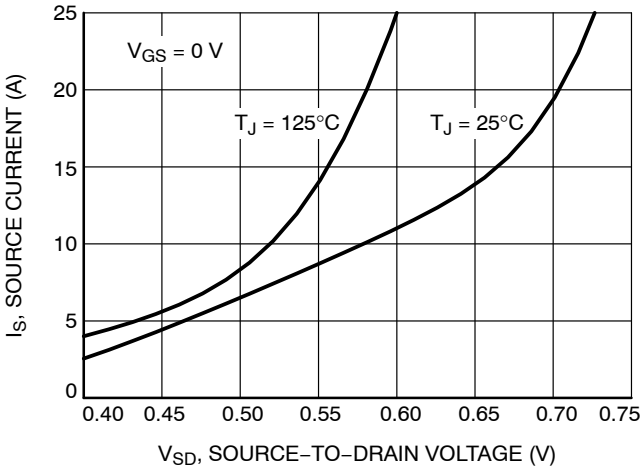



**Figure 10. Diode Forward Voltage vs. Current**

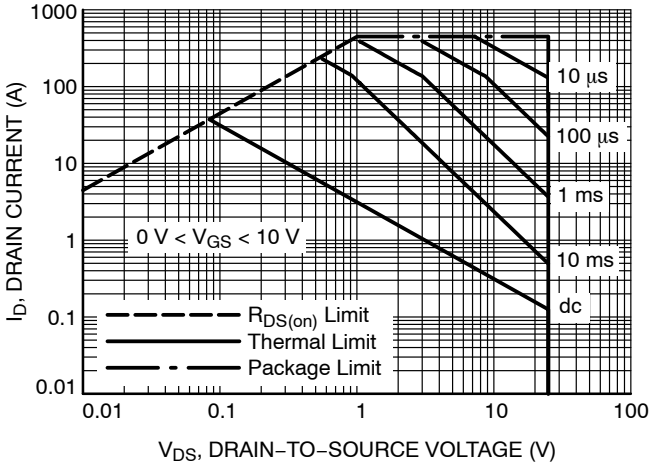



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

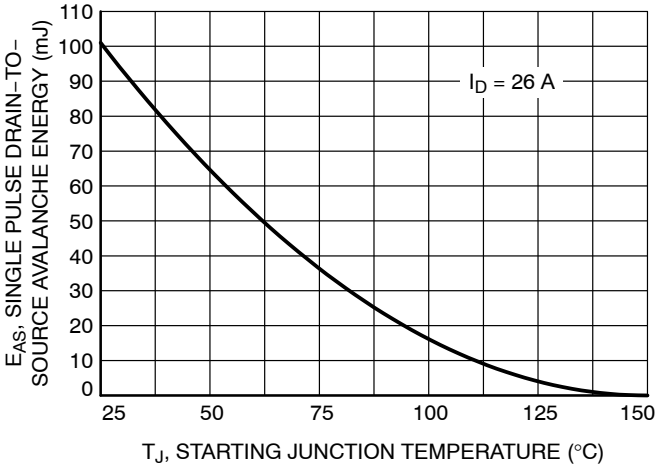



**Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature**

## TYPICAL CHARACTERISTICS

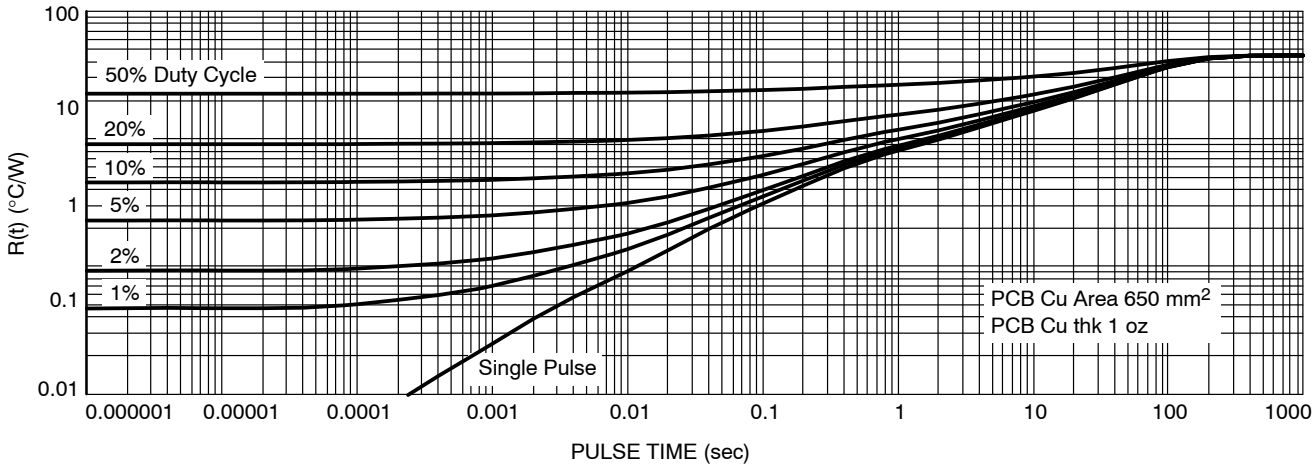



**Figure 13. Thermal Characteristics**

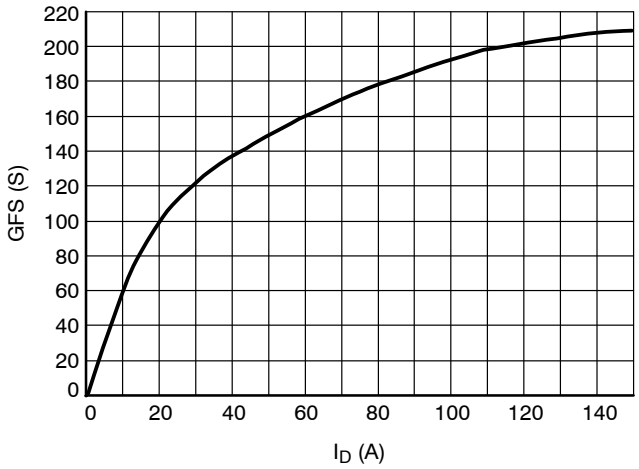



**Figure 14. GFS vs. $I_D$**

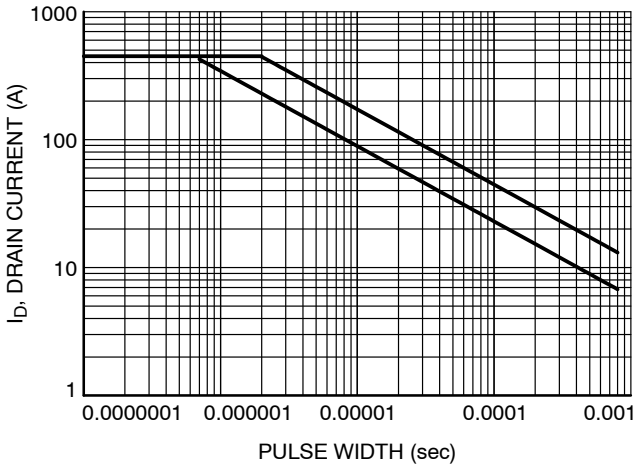
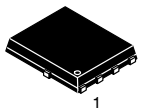



**Figure 15. Avalanche Characteristics**

### ORDERING INFORMATION

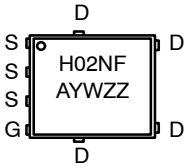
| Device | Package | Shipping† |
|---|---|---|
| NTMFS4H02NFT1G | SO8−FL (Pb-Free) | 1500 / Tape & Reel |
| NTMFS4H02NFT3G | SO8−FL (Pb-Free) | 5000 / Tape & Reel |

†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.




**SO−8 FLAT LEAD**
**CASE 488AA**
**STYLE 1**

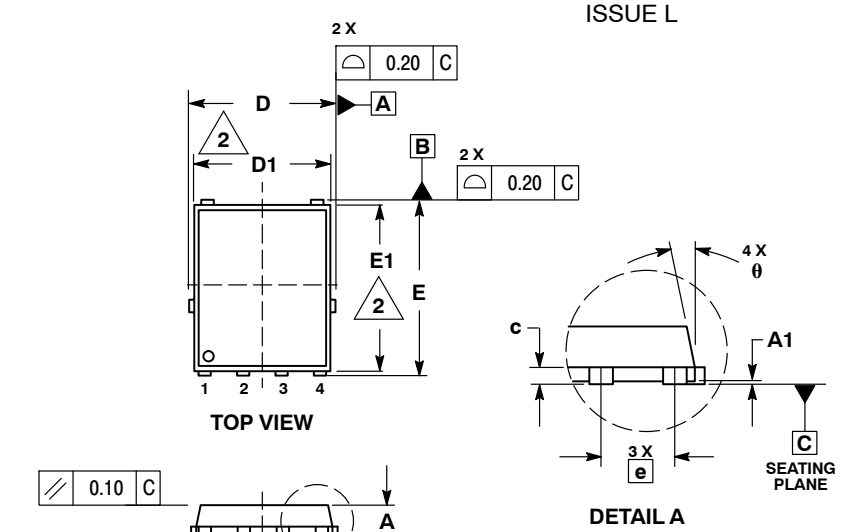
**MARKING DIAGRAM**

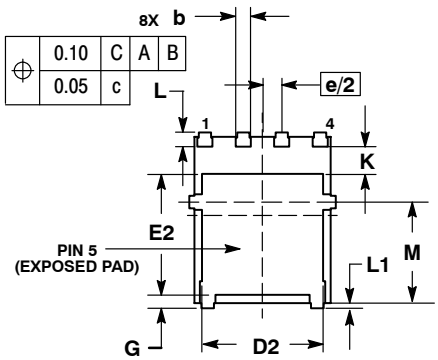



| | |
|---|---|
| A | = Assembly Location |
| Y | = Year |
| W | = Work Week |
| ZZ | = Lot Traceability |

## PACKAGE DIMENSIONS

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



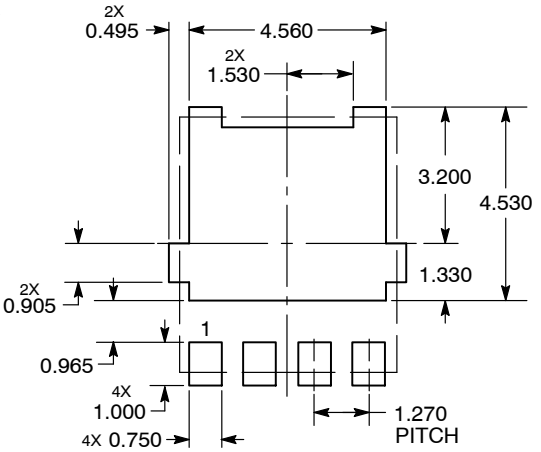




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION D1 AND E1 DO NOT INCLUDE MOLD FLASH PROTRUSIONS OR GATE BURRS.

| | 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 | 0.61 | 0.71 |
| K | 1.20 | 1.35 | 1.50 |
| L | 0.51 | 0.61 | 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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