

# NTMFS4H02NF

## Power MOSFET

25 V, 193 A, Single N-Channel, SO-8FL

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

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

### THERMAL CHARACTERISTICS

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

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



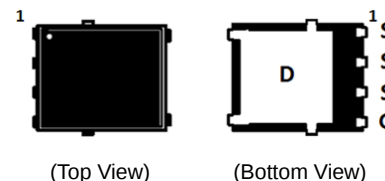
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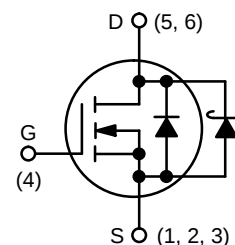
| $V_{GS}$ | MAX $R_{DS(on)}$     | TYP $Q_{GTOT}$ |
|----------|----------------------|----------------|
| 4.5 V    | 2.3 $\text{m}\Omega$ | 17.4 nC        |
| 10 V     | 1.4 $\text{m}\Omega$ | 39.3 nC        |

### PIN CONNECTIONS

SO8-FL (5 x 6 mm)



### N-CHANNEL MOSFET



### ORDERING INFORMATION

See detailed ordering, marking and shipping information on page 6 of this data sheet.

# NTMFS4H02NF

## 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                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$                 | 25 |      |      | V                    |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ |                                                                     |    | 18.6 |      | mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}, T_J = 25^\circ\text{C}$ |    |      | 500  | $\mu\text{A}$        |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{DS} = 0\text{ V}, V_{GS} = +20\text{ V}$                        |    |      | +100 | nA                   |

### ON CHARACTERISTICS (Note 5)

|                                            |                  |                                                 |     |     |     |                      |
|--------------------------------------------|------------------|-------------------------------------------------|-----|-----|-----|----------------------|
| Gate Threshold Voltage                     | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$ | 1.2 |     | 2.1 | V                    |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ |                                                 |     | 3.3 |     | mV/ $^\circ\text{C}$ |
| Drain-to-Source On Resistance              | $R_{DS(on)}$     | $V_{GS} = 10\text{ V}, I_D = 30\text{ A}$       |     | 1.1 | 1.4 | m $\Omega$           |
|                                            |                  | $V_{GS} = 4.5\text{ V}, I_D = 30\text{ A}$      |     | 1.6 | 2.3 |                      |
| Forward Transconductance                   | $g_{FS}$         | $V_{DS} = 12\text{ V}, I_D = 15\text{ A}$       |     | 84  |     | S                    |

### CHARGES, CAPACITANCES & GATE RESISTANCE

|                              |              |                                                                  |  |      |   |          |
|------------------------------|--------------|------------------------------------------------------------------|--|------|---|----------|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 12\text{ V}$    |  | 2652 |   | pF       |
| Output Capacitance           | $C_{OSS}$    |                                                                  |  | 1644 |   |          |
| Reverse Transfer Capacitance | $C_{RSS}$    |                                                                  |  | 94   |   |          |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 12\text{ V}, I_D = 30\text{ A}$ |  | 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            | $Q_{G(TOT)}$ | $V_{GS} = 10\text{ V}, V_{DS} = 12\text{ V}, I_D = 30\text{ A}$  |  | 40.9 |   | nC       |
| Gate Resistance              | $R_G$        | $T_A = 25^\circ\text{C}$                                         |  | 1.0  | 2 | $\Omega$ |

### SWITCHING CHARACTERISTICS, $V_{GS} = 4.5\text{ V}$ (Note 5)

|                     |              |                                                                                           |  |      |  |    |
|---------------------|--------------|-------------------------------------------------------------------------------------------|--|------|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = 4.5\text{ V}, V_{DD} = 12\text{ V}, I_D = 15\text{ A}, R_G = 3.0\text{ }\Omega$ |  | 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, $V_{GS} = 10\text{ V}$ (Note 5)

|                     |              |                                                                                          |  |      |  |    |
|---------------------|--------------|------------------------------------------------------------------------------------------|--|------|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = 10\text{ V}, V_{DD} = 12\text{ V}, I_D = 15\text{ A}, R_G = 3.0\text{ }\Omega$ |  | 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   | $V_{SD}$ | $V_{GS} = 0\text{ V},$<br>$I_S = 2.0\text{ A}$                                    | $T_J = 25^{\circ}\text{C}$  |  | 0.38 | 0.6 | V  |
|                         |          |                                                                                   | $T_J = 125^{\circ}\text{C}$ |  | 0.29 |     |    |
| Reverse Recovery Time   | $t_{RR}$ | $V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s},$<br>$I_S = 30\text{ A}$ |                             |  | 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  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .

6. Switching characteristics are independent of operating junction temperatures.

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

| Parameter                       | Symbol | Test Condition           | Min | Typ  | Max | Unit |
|---------------------------------|--------|--------------------------|-----|------|-----|------|
| <b>PACKAGE PARASITIC VALUES</b> |        |                          |     |      |     |      |
| Source Inductance               | $L_S$  | $T_A = 25^\circ\text{C}$ |     | 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  $\leq 300 \mu\text{s}$ , duty cycle  $\leq 2\%$ .

6. Switching characteristics are independent of operating junction temperatures.

TYPICAL CHARACTERISTICS

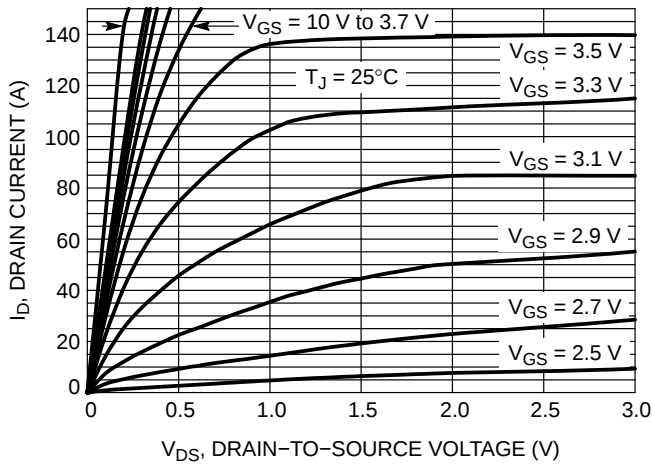


Figure 1. On-Region Characteristics

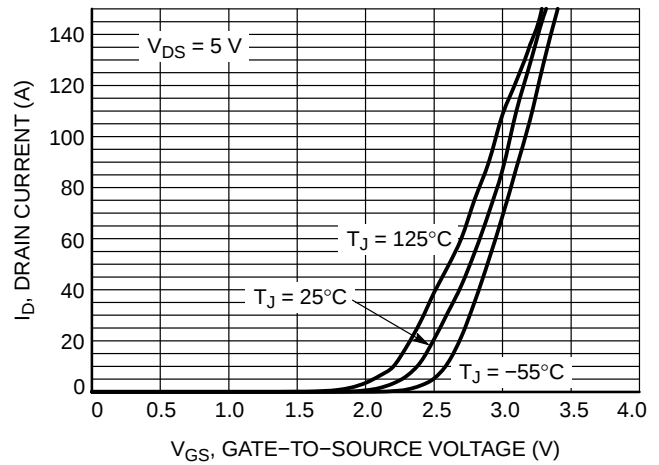


Figure 2. Transfer Characteristics

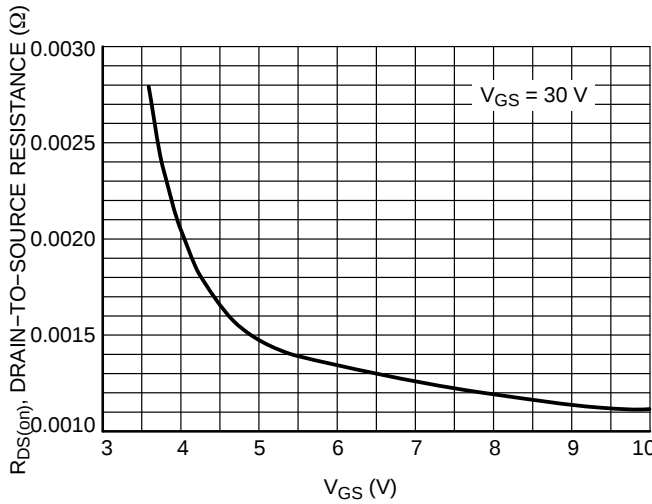


Figure 3. On-Resistance vs.  $V_{GS}$

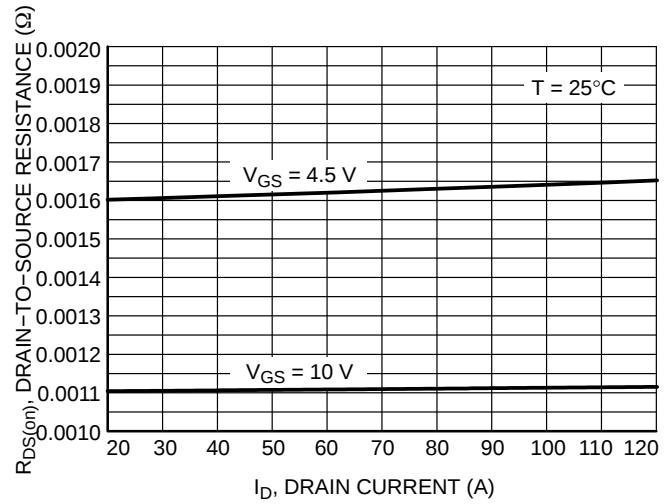


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

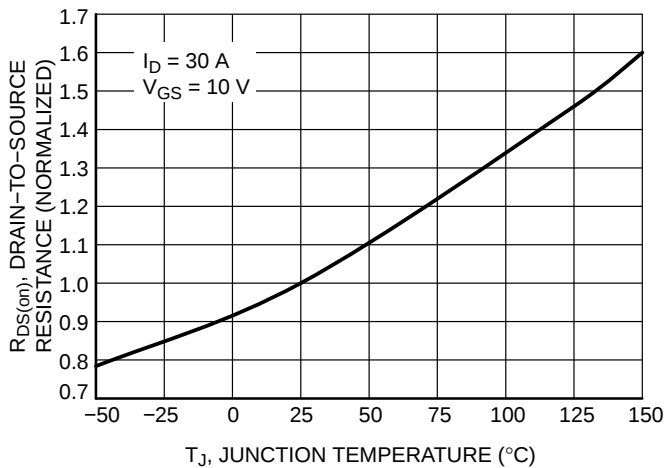


Figure 5. On-Resistance Variation with Temperature

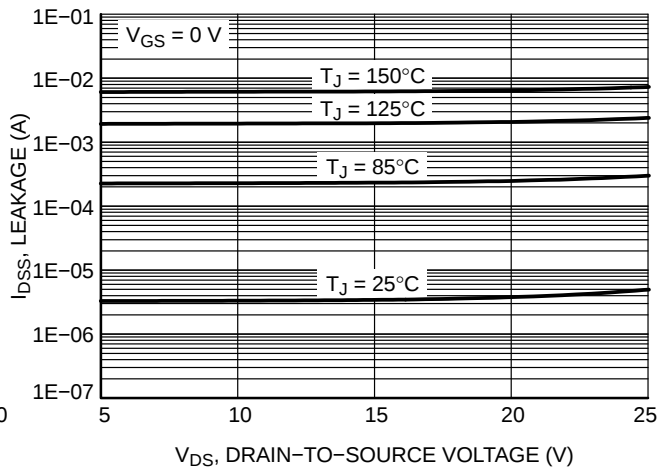


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

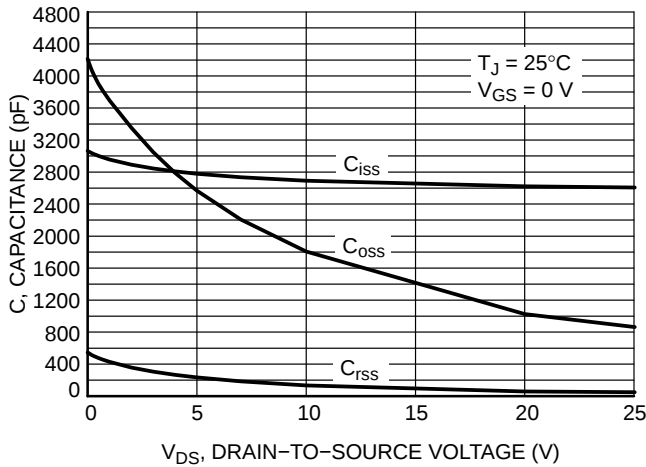


Figure 7. Capacitance Variation

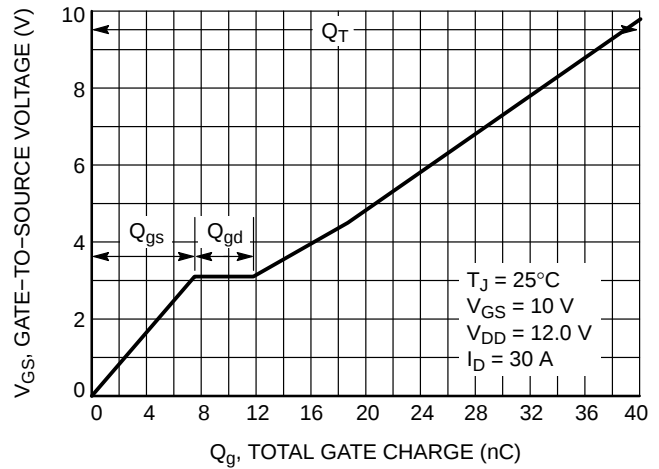


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

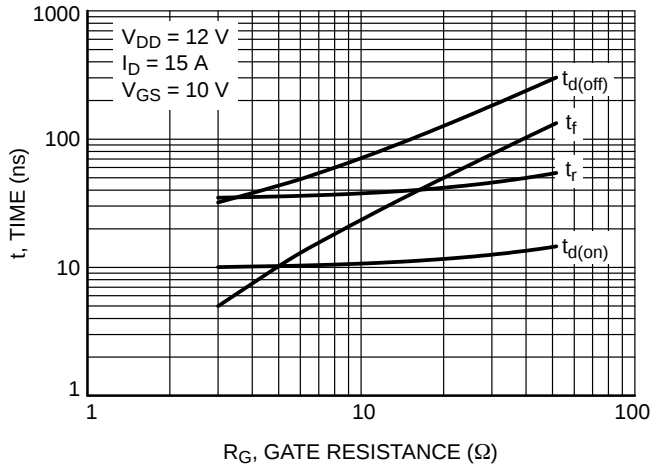


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

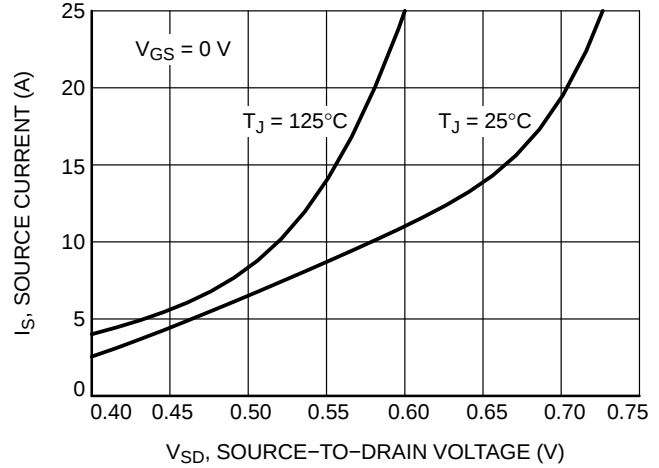


Figure 10. Diode Forward Voltage vs. Current

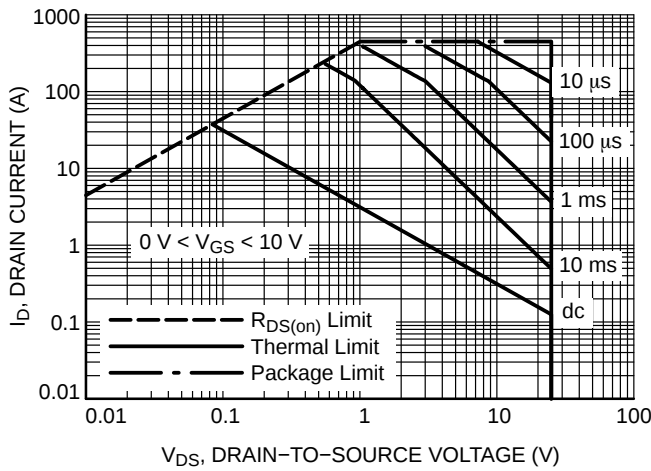


Figure 11. Maximum Rated Forward Biased Safe Operating Area

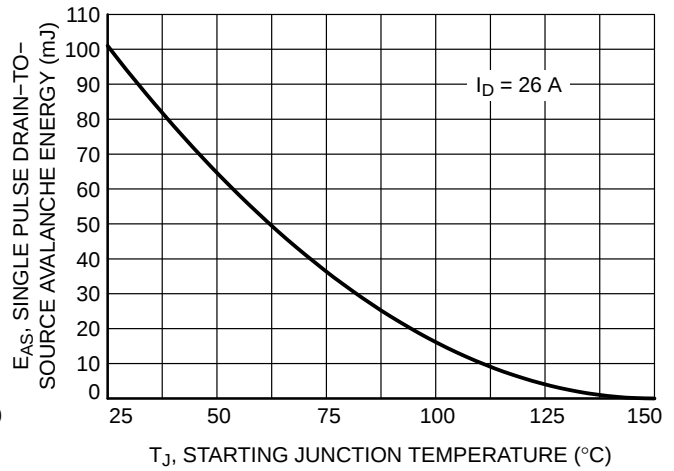


Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature

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## TYPICAL CHARACTERISTICS

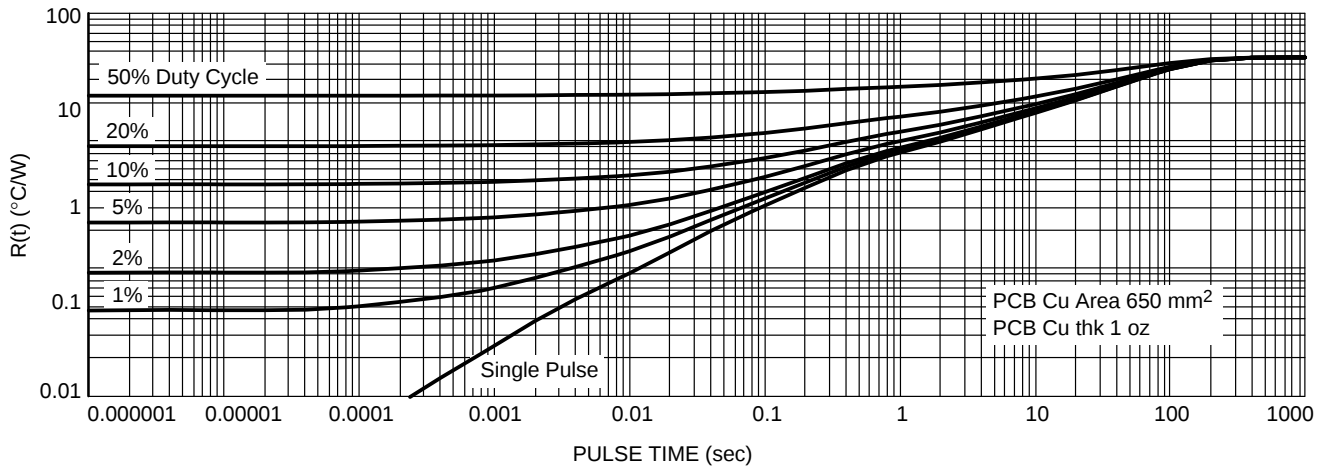


Figure 13. Thermal Characteristics

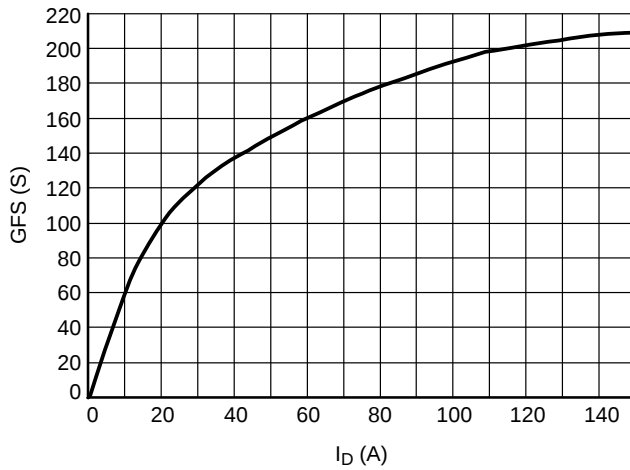


Figure 14. GFS vs.  $I_D$

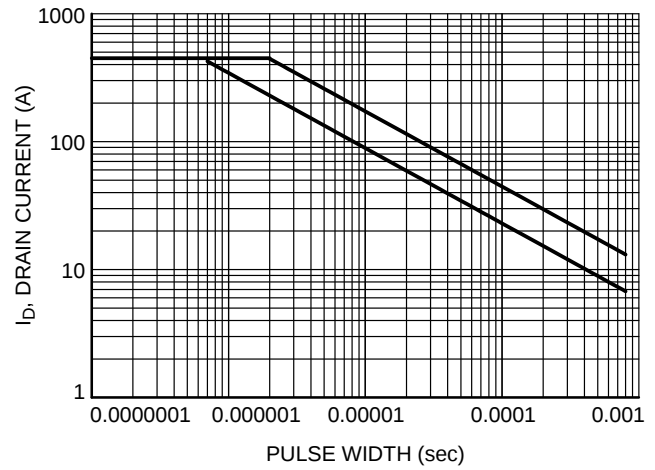


Figure 15. Avalanche Characteristics

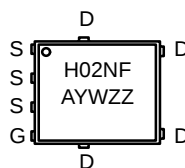
## ORDERING INFORMATION

| Device         | Package             | Shipping <sup>†</sup> |
|----------------|---------------------|-----------------------|
| NTMFS4H02NFT1G | SO8-FL<br>(Pb-Free) | 1500 / Tape & Reel    |
| NTMFS4H02NFT3G | SO8-FL<br>(Pb-Free) | 5000 / 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.



## MARKING DIAGRAM

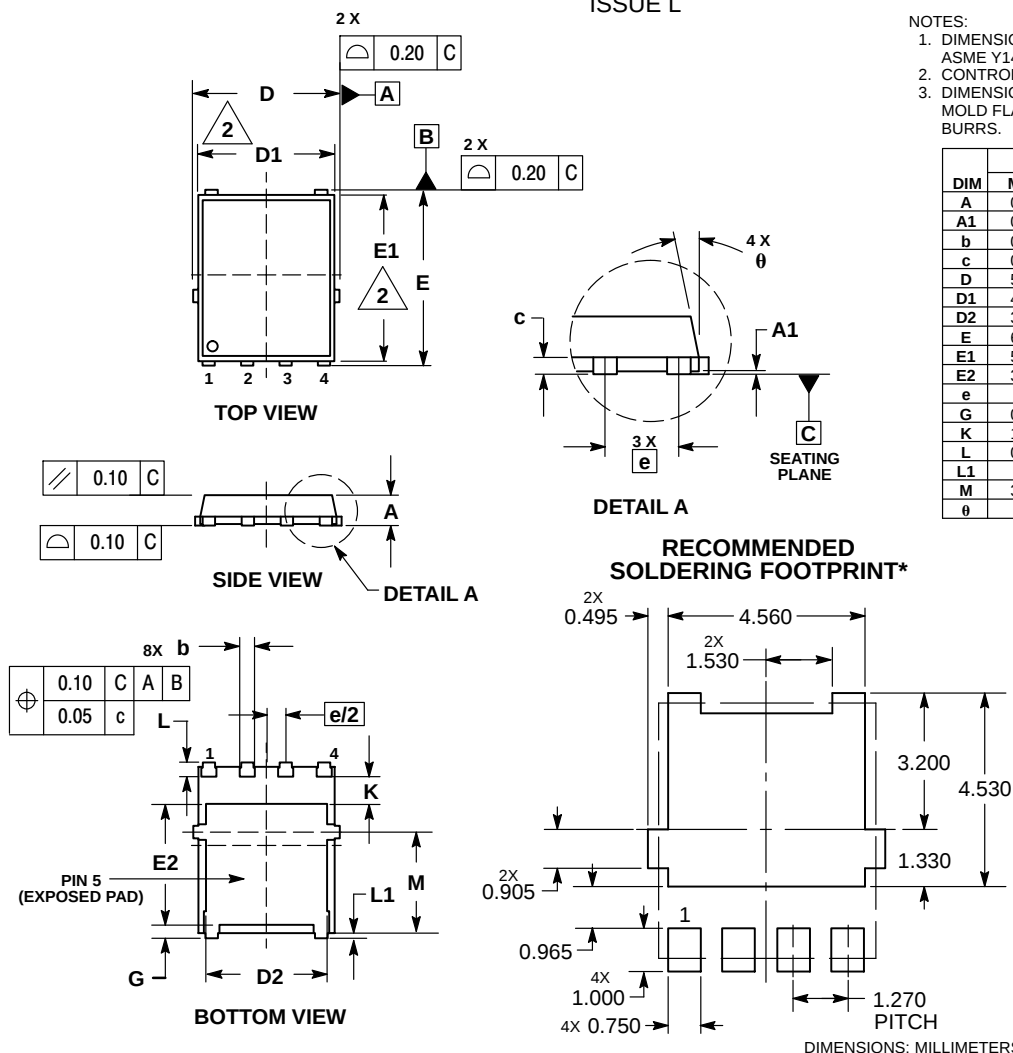


A = Assembly Location  
Y = Year  
W = Work Week  
ZZ = Lot Traceability

# NTMFS4H02NF

## 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.

| 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        | 0.61 | 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 |
| theta | 0 °         | —    | 12 ° |

### STYLE 1:

- PIN 1. SOURCE
- SOURCE
- SOURCE
- GATE
- 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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NTMFS4H02NF/D



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- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



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