

# NTMS4939N

## Power MOSFET

30 V, 12.5 A, N-Channel, SO-8

### 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

- DC-DC Converters
- Points of Loads
- Power Load Switch
- Motor Controls

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

| Parameter                                                                                                                                                                   |                                                   | Symbol            | Value                    | Unit             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|-------------------|--------------------------|------------------|
| Drain-to-Source Voltage                                                                                                                                                     |                                                   | $V_{DS}$          | 30                       | V                |
| Gate-to-Source Voltage                                                                                                                                                      |                                                   | $V_{GS}$          | $\pm 20$                 | V                |
| Continuous Drain Current $R_{\theta JA}$ (Note 1)                                                                                                                           | Steady State                                      | $I_D$             | $T_A = 25^\circ\text{C}$ | A                |
|                                                                                                                                                                             |                                                   |                   | $T_A = 70^\circ\text{C}$ |                  |
| Power Dissipation $R_{\theta JA}$ (Note 1)                                                                                                                                  | Steady State                                      | $P_D$             | $T_A = 25^\circ\text{C}$ | W                |
|                                                                                                                                                                             |                                                   |                   | $T_A = 70^\circ\text{C}$ |                  |
| Continuous Drain Current $R_{\theta JA}$ (Note 2)                                                                                                                           | Steady State                                      | $I_D$             | $T_A = 25^\circ\text{C}$ | A                |
|                                                                                                                                                                             |                                                   |                   | $T_A = 70^\circ\text{C}$ |                  |
| Power Dissipation $R_{\theta JA}$ (Note 2)                                                                                                                                  | Steady State                                      | $P_D$             | $T_A = 25^\circ\text{C}$ | W                |
|                                                                                                                                                                             |                                                   |                   | $T_A = 70^\circ\text{C}$ |                  |
| Continuous Drain Current $R_{\theta JA}$ , $t \leq 10$ s (Note 1)                                                                                                           | Steady State                                      | $I_D$             | $T_A = 25^\circ\text{C}$ | A                |
|                                                                                                                                                                             |                                                   |                   | $T_A = 70^\circ\text{C}$ |                  |
| Power Dissipation $R_{\theta JA}$ , $t \leq 10$ s (Note 1)                                                                                                                  | Steady State                                      | $P_D$             | $T_A = 25^\circ\text{C}$ | W                |
|                                                                                                                                                                             |                                                   |                   | $T_A = 70^\circ\text{C}$ |                  |
| Pulsed Drain Current                                                                                                                                                        | $T_A = 25^\circ\text{C}$ , $t_p = 10 \mu\text{s}$ | $I_{DM}$          | 100                      | A                |
| Operating Junction and Storage Temperature                                                                                                                                  |                                                   | $T_J$ , $T_{stg}$ | -55 to 150               | $^\circ\text{C}$ |
| Source Current (Body Diode)                                                                                                                                                 |                                                   | $I_S$             | 2.0                      | A                |
| Single Pulse Drain-to-Source Avalanche Energy ( $T_J = 25^\circ\text{C}$ , $V_{DD} = 30$ V, $V_{GS} = 10$ V, $I_L = 11$ A <sub>pk</sub> , $L = 1.0$ mH, $R_G = 25 \Omega$ ) |                                                   | $E_{AS}$          | 60.5                     | 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-Ambient – Steady State (Note 1)  | $R_{\theta JA}$ | 92.7  | $^\circ\text{C/W}$ |
| Junction-to-Ambient – $t \leq 10$ s (Note 1) | $R_{\theta JA}$ | 61.7  |                    |
| Junction-to-Foot (Drain)                     | $R_{\theta JF}$ | 23.5  |                    |
| Junction-to-Ambient – Steady State (Note 2)  | $R_{\theta JA}$ | 155.6 |                    |

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

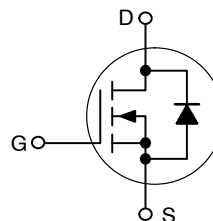


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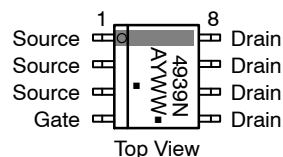
| $V_{(BR)DSS}$ | $R_{DS(ON)} \text{ MAX}$ | $I_D \text{ MAX}$ |
|---------------|--------------------------|-------------------|
| 30 V          | 8.4 m $\Omega$ @ 10 V    | 12.5 A            |
|               | 11 m $\Omega$ @ 4.5 V    |                   |

### N-Channel



SO-8  
CASE 751  
STYLE 12

### MARKING DIAGRAM/ PIN ASSIGNMENT



4939N = Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
■ = Pb-Free Package  
(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device       | Package        | Shipping†        |
|--------------|----------------|------------------|
| NTMS4939NR2G | SO-8 (Pb-Free) | 2500/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.

# NTMS4939N

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

| Parameter                                                 | Symbol            | Test Condition                                      | Min                       | Typ  | Max       | Unit                 |
|-----------------------------------------------------------|-------------------|-----------------------------------------------------|---------------------------|------|-----------|----------------------|
| <b>OFF CHARACTERISTICS</b>                                |                   |                                                     |                           |      |           |                      |
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | 30                        |      |           | V                    |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ |                                                     |                           | 13.8 |           | mV/ $^\circ\text{C}$ |
| 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                            | $I_{GSS}$         | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$     |                           |      | $\pm 100$ | nA                   |

## ON CHARACTERISTICS (Note 3)

|                                            |                  |                                                 |     |      |     |                      |
|--------------------------------------------|------------------|-------------------------------------------------|-----|------|-----|----------------------|
| Gate Threshold Voltage                     | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$ | 1.0 |      | 2.5 | V                    |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ |                                                 |     | 5.0  |     | mV/ $^\circ\text{C}$ |
| Drain-to-Source On Resistance              | $R_{DS(on)}$     | $V_{GS} = 10\text{ V}, I_D = 7.5\text{ A}$      |     | 7.0  | 8.4 | m $\Omega$           |
|                                            |                  | $V_{GS} = 4.5\text{ V}, I_D = 6.5\text{ A}$     |     | 9.0  | 11  |                      |
| Forward Transconductance                   | $g_{FS}$         | $V_{DS} = 1.5\text{ V}, I_D = 7.5\text{ A}$     |     | 23.8 |     | S                    |

## CHARGES, CAPACITANCES AND GATE RESISTANCE

|                              |              |                                                                   |  |      |  |    |
|------------------------------|--------------|-------------------------------------------------------------------|--|------|--|----|
| Input Capacitance            | $C_{iss}$    | $V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 25\text{ V}$   |  | 2000 |  | pF |
| Output Capacitance           | $C_{oss}$    |                                                                   |  | 620  |  |    |
| Reverse Transfer Capacitance | $C_{rss}$    |                                                                   |  | 16   |  |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 7.5\text{ A}$ |  | 12.4 |  | nC |
| Threshold Gate Charge        | $Q_{G(TH)}$  |                                                                   |  | 3.3  |  |    |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                   |  | 5.3  |  |    |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                   |  | 1.85 |  |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}, I_D = 7.5\text{ A}$  |  | 25   |  | nC |

## SWITCHING CHARACTERISTICS (Note 4)

|                     |              |                                                                                           |  |      |  |    |
|---------------------|--------------|-------------------------------------------------------------------------------------------|--|------|--|----|
| Turn-On Delay Time  | $t_{d(on)}$  | $V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}, I_D = 1.0\text{ A}, R_G = 6.0\text{ }\Omega$ |  | 10.6 |  | ns |
| Rise Time           | $t_r$        |                                                                                           |  | 3.1  |  |    |
| Turn-Off Delay Time | $t_{d(off)}$ |                                                                                           |  | 36.7 |  |    |
| Fall Time           | $t_f$        |                                                                                           |  | 21.5 |  |    |

## DRAIN-SOURCE DIODE CHARACTERISTICS

|                         |          |                                                                               |                           |      |      |     |    |
|-------------------------|----------|-------------------------------------------------------------------------------|---------------------------|------|------|-----|----|
| Forward Diode Voltage   | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = 2.0\text{ A}$                                     | $T_J = 25^\circ\text{C}$  |      | 0.73 | 1.0 | V  |
|                         |          |                                                                               | $T_J = 125^\circ\text{C}$ |      | 0.57 |     |    |
| Reverse Recovery Time   | $t_{RR}$ | $V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s}, I_S = 2.0\text{ A}$ |                           | 36.3 |      |     | ns |
| Charge Time             | $t_a$    |                                                                               |                           | 17.8 |      |     |    |
| Discharge Time          | $t_b$    |                                                                               |                           | 18.5 |      |     |    |
| Reverse Recovery Charge | $Q_{RR}$ |                                                                               |                           | 32   |      |     | nC |

## PACKAGE PARASITIC VALUES

|                   |       |                          |  |      |     |          |
|-------------------|-------|--------------------------|--|------|-----|----------|
| Source Inductance | $L_S$ | $T_A = 25^\circ\text{C}$ |  | 0.66 |     | nH       |
| Drain Inductance  | $L_D$ |                          |  | 0.2  |     |          |
| Gate Inductance   | $L_G$ |                          |  | 1.5  |     |          |
| Gate Resistance   | $R_G$ |                          |  | 0.4  | 1.0 | $\Omega$ |

3. Pulse Test: pulse width = 300  $\mu\text{s}$ , duty cycle  $\leq 2\%$ .

4. Switching characteristics are independent of operating junction temperatures.

TYPICAL PERFORMANCE CURVES

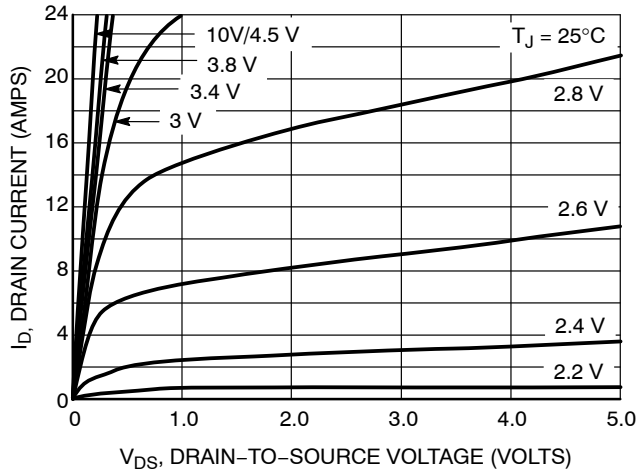


Figure 1. On-Region Characteristics

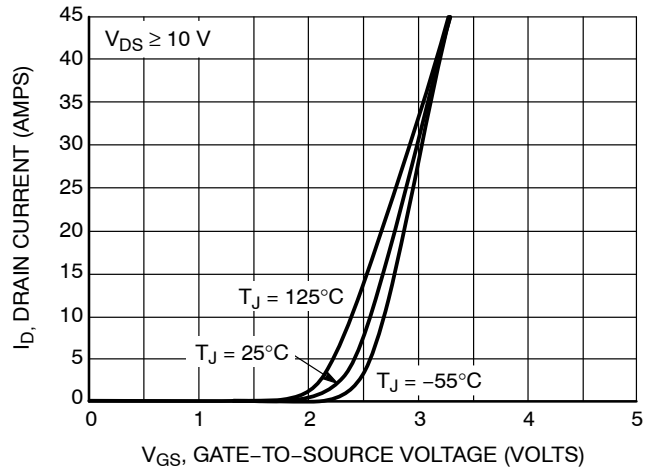


Figure 2. Transfer Characteristics

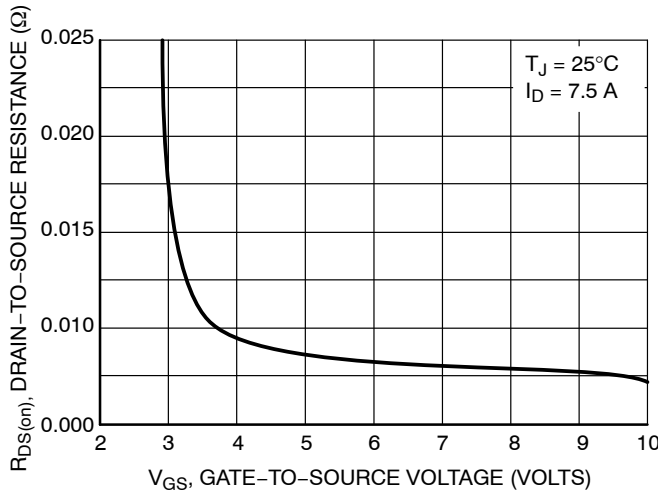


Figure 3. On-Resistance vs. Gate-to-Source Voltage

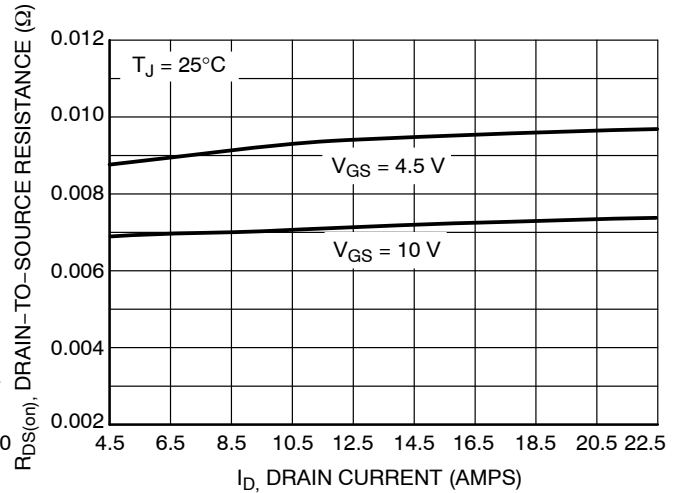


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

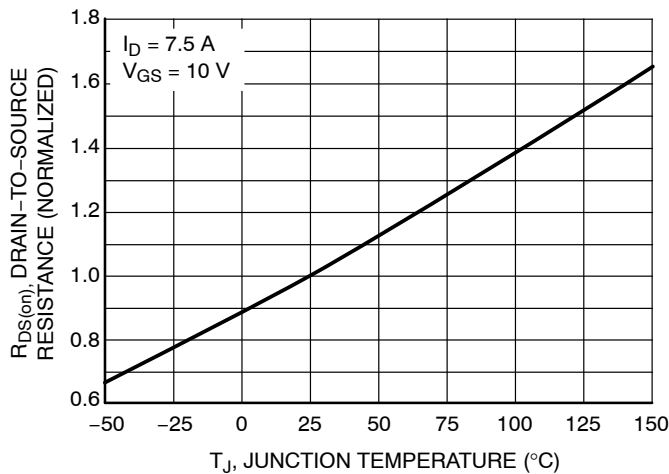


Figure 5. On-Resistance Variation with Temperature

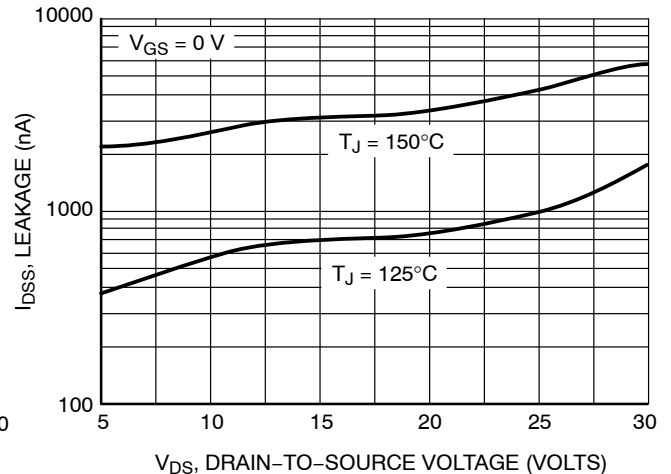


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL PERFORMANCE CURVES

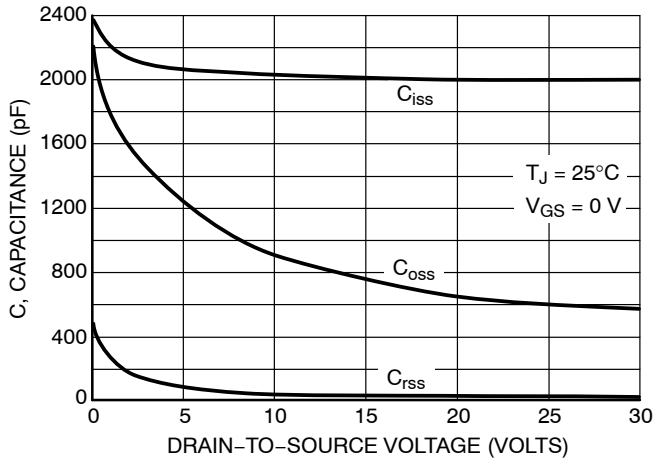


Figure 7. Capacitance Variation

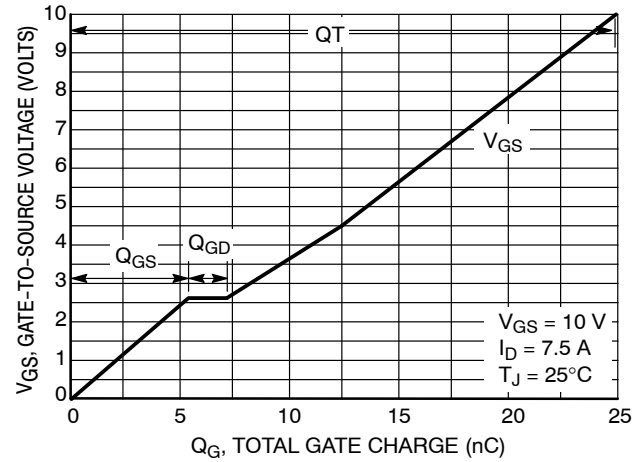


Figure 8. Gate-To-Source and Drain-To-Source Voltage vs. Total Charge

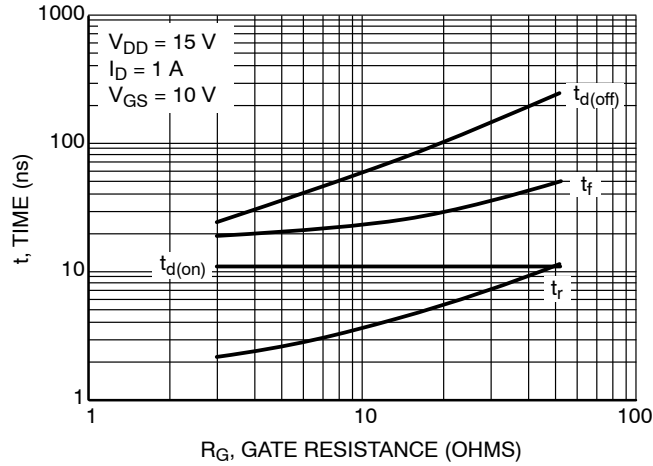


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

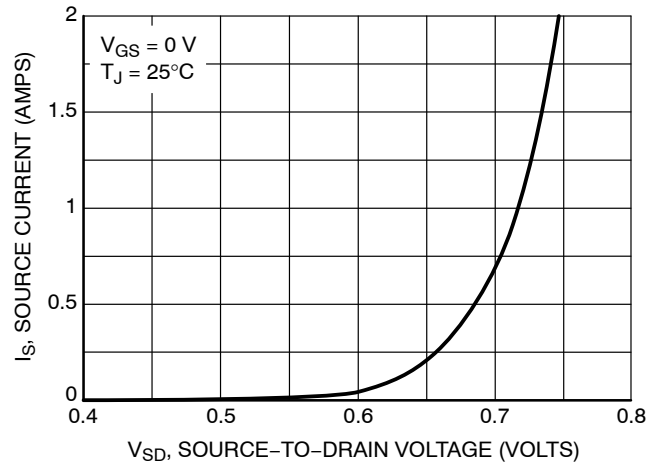


Figure 10. Diode Forward Voltage vs. Current

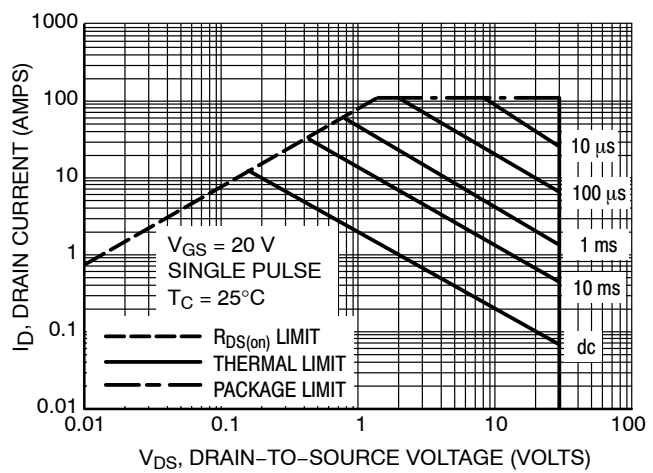


Figure 11. Maximum Rated Forward Biased Safe Operating Area

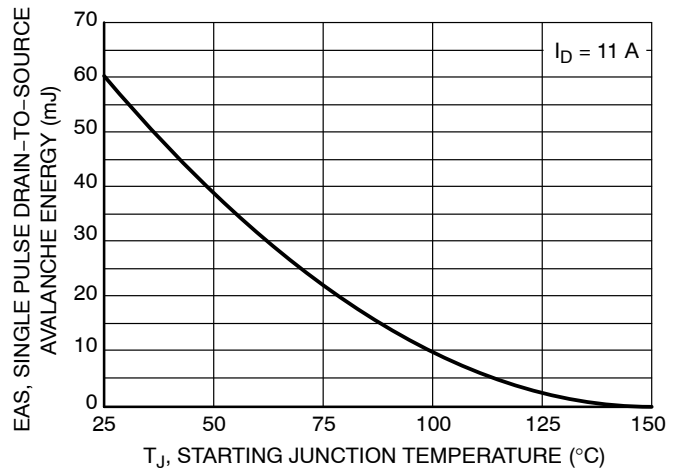
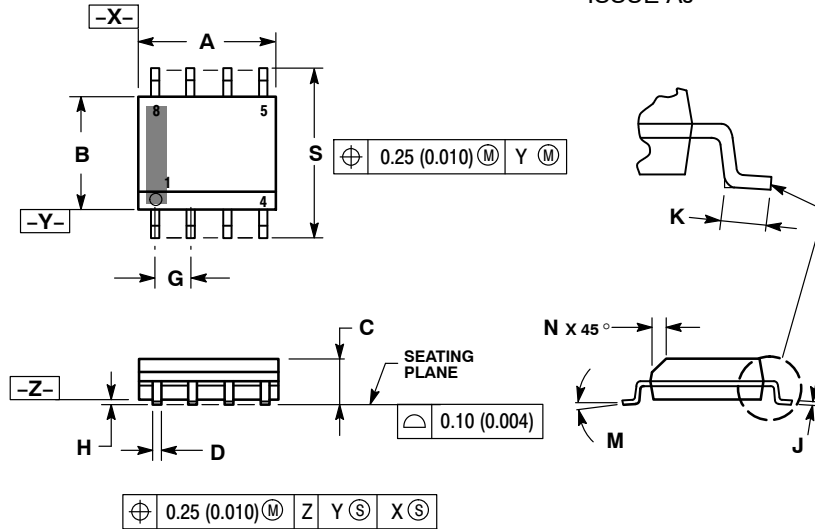


Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature

# NTMS4939N

## PACKAGE DIMENSIONS

### SOIC-8 CASE 751-07 ISSUE AJ

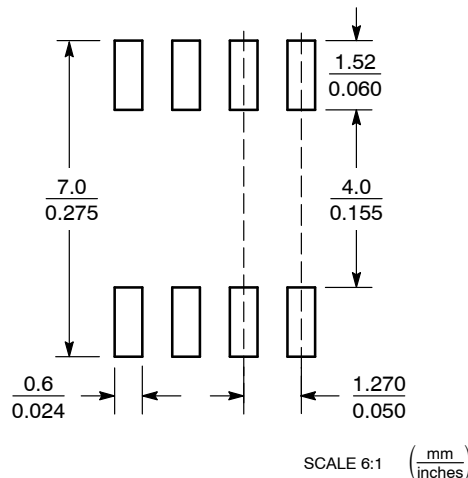


#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 4.80        | 5.00 | 0.189     | 0.197 |
| B   | 3.80        | 4.00 | 0.150     | 0.157 |
| C   | 1.35        | 1.75 | 0.053     | 0.069 |
| D   | 0.33        | 0.51 | 0.013     | 0.020 |
| G   | 1.27 BSC    |      | 0.050 BSC |       |
| H   | 0.10        | 0.25 | 0.004     | 0.010 |
| J   | 0.19        | 0.25 | 0.007     | 0.010 |
| K   | 0.40        | 1.27 | 0.016     | 0.050 |
| M   | 0°          | 8°   | 0°        | 8°    |
| N   | 0.25        | 0.50 | 0.010     | 0.020 |
| S   | 5.80        | 6.20 | 0.228     | 0.244 |

### SOLDERING FOOTPRINT\*



#### STYLE 12:

- PIN 1. SOURCE
- SOURCE
- SOURCE
- GATE
- DRAIN
- DRAIN
- DRAIN
- 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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