

# NTMS10P02R2

## Power MOSFET -10 Amps, -20 Volts P-Channel Enhancement-Mode Single SO-8 Package

### Features

- Ultra Low  $R_{DS(on)}$
- Higher Efficiency Extending Battery Life
- Logic Level Gate Drive
- Miniature SO-8 Surface Mount Package
- Diode Exhibits High Speed, Soft Recovery
- Avalanche Energy Specified
- SO-8 Mounting Information Provided

### Applications

- Power Management in Portable and Battery-Powered Products, i.e.: Cellular and Cordless Telephones and PCMCIA Cards

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

| Rating   | Symbol          | Value          | Unit               |
|--|-----------------|----------------|--------------------|
| Drain-to-Source Voltage  | $V_{DS}$        | -20            | Vdc                |
| Gate-to-Source Voltage – Continuous  | $V_{GS}$        | $\pm 12$       | Vdc                |
| Thermal Resistance –<br>Junction-to-Ambient (Note 1.)  | $R_{\theta JA}$ | 50             | $^\circ\text{C/W}$ |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$   | $P_D$           | 2.5            | W                  |
| Continuous Drain Current @ $25^\circ\text{C}$  | $I_D$           | -10            | A                  |
| Continuous Drain Current @ $70^\circ\text{C}$  | $I_D$           | -8.0           | A                  |
| Maximum Operating Power Dissipation  | $P_D$           | 0.6            | W                  |
| Maximum Operating Drain Current  | $I_D$           | -5.5           | A                  |
| Pulsed Drain Current (Note 3.)   | $I_{DM}$        | -50            | A                  |
| Thermal Resistance –<br>Junction-to-Ambient (Note 2.)  | $R_{\theta JA}$ | 80             | $^\circ\text{C/W}$ |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$   | $P_D$           | 1.6            | W                  |
| Continuous Drain Current @ $25^\circ\text{C}$  | $I_D$           | -8.8           | A                  |
| Continuous Drain Current @ $70^\circ\text{C}$  | $I_D$           | -6.4           | A                  |
| Maximum Operating Power Dissipation  | $P_D$           | 0.4            | W                  |
| Maximum Operating Drain Current  | $I_D$           | -4.5           | A                  |
| Pulsed Drain Current (Note 3.)   | $I_{DM}$        | -44            | A                  |
| Operating and Storage<br>Temperature Range   | $T_J, T_{stg}$  | -55 to<br>+150 | $^\circ\text{C}$   |
| Single Pulse Drain-to-Source Avalanche<br>Energy – Starting $T_J = 25^\circ\text{C}$<br>( $V_{DD} = -20\text{ Vdc}$ , $V_{GS} = -4.5\text{ Vdc}$ ,<br>Peak $I_L = 5.0\text{ Apk}$ , $L = 40\text{ mH}$ ,<br>$R_G = 25\ \Omega$ ) | $E_{AS}$        | 500            | mJ                 |
| Maximum Lead Temperature for Soldering<br>Purposes, 1/8" from case for 10 seconds  | $T_L$           | 260            | $^\circ\text{C}$   |

1. Mounted onto a 2" square FR-4 Board (1" sq. Cu 0.06" thick single sided),  $t = 10$  seconds.
2. Mounted onto a 2" square FR-4 Board (1" sq. Cu 0.06" thick single sided),  $t =$  steady state.
3. Pulse Test: Pulse Width < 300  $\mu\text{s}$ , Duty Cycle < 2%.

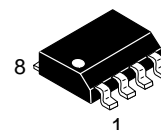
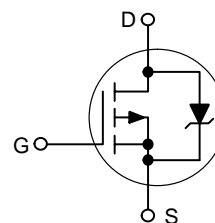


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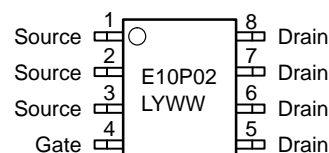
**-10 AMPERES  
-20 VOLTS  
14 m $\Omega$  @  $V_{GS} = -4.5\text{ V}$**

### P-Channel



**SO-8  
CASE 751  
STYLE 12**

### MARKING DIAGRAM & PIN ASSIGNMENT



Top View

E10P02 = Device Code  
L = Assembly Location  
Y = Year  
WW = Work Week

### ORDERING INFORMATION

| Device      | Package | Shipping†        |
|-------------|---------|------------------|
| NTMS10P02R2 | SO-8    | 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.

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## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted) (Note 4.)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|   |                      |          |            |              |              |
|---|----------------------|----------|------------|--------------|--------------|
| Drain-to-Source Breakdown Voltage<br>(V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = -250 μAdc)<br>Temperature Coefficient (Positive)  | V <sub>(BR)DSS</sub> | -20<br>- | -<br>-12.1 | -<br>-       | Vdc<br>mV/°C |
| Zero Gate Voltage Drain Current<br>(V <sub>DS</sub> = -20 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 25°C)<br>(V <sub>DS</sub> = -20 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 70°C) | I <sub>DSS</sub>     | -<br>-   | -<br>-     | -1.0<br>-5.0 | μAdc         |
| Gate-Body Leakage Current<br>(V <sub>GS</sub> = -12 Vdc, V <sub>DS</sub> = 0 Vdc)   | I <sub>GSS</sub>     | -        | -          | -100         | nAdc         |
| Gate-Body Leakage Current<br>(V <sub>GS</sub> = +12 Vdc, V <sub>DS</sub> = 0 Vdc)   | I <sub>GSS</sub>     | -        | -          | 100          | nAdc         |

### ON CHARACTERISTICS

|   |                     |           |                |                |              |
|---|---------------------|-----------|----------------|----------------|--------------|
| Gate Threshold Voltage<br>(V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μAdc)<br>Temperature Coefficient (Negative)                                | V <sub>GS(th)</sub> | -0.6<br>- | -0.88<br>2.8   | -1.20<br>-     | Vdc<br>mV/°C |
| Static Drain-to-Source On-State Resistance<br>(V <sub>GS</sub> = -4.5 Vdc, I <sub>D</sub> = -10 Adc)<br>(V <sub>GS</sub> = -2.5 Vdc, I <sub>D</sub> = -8.8 Adc) | R <sub>DS(on)</sub> | -<br>-    | 0.012<br>0.017 | 0.014<br>0.020 | Ω            |
| Forward Transconductance (V <sub>DS</sub> = -10 Vdc, I <sub>D</sub> = -10 Adc)  | g <sub>FS</sub>     | -         | 30             | -              | Mhos         |

### DYNAMIC CHARACTERISTICS

|                              |  |                  |   |      |      |    |
|------------------------------|--|------------------|---|------|------|----|
| Input Capacitance            | (V <sub>DS</sub> = -16 Vdc, V <sub>GS</sub> = 0 Vdc,<br>f = 1.0 MHz) | C <sub>iss</sub> | - | 3100 | 3640 | pF |
| Output Capacitance           |  | C <sub>oss</sub> | - | 1100 | 1670 |    |
| Reverse Transfer Capacitance |  | C <sub>rss</sub> | - | 475  | 1010 |    |

### SWITCHING CHARACTERISTICS (Notes 5. & 6.)

|                     |  |                     |   |     |     |    |
|---------------------|--|---------------------|---|-----|-----|----|
| Turn-On Delay Time  | (V <sub>DD</sub> = -10 Vdc, I <sub>D</sub> = -1.0 Adc,<br>V <sub>GS</sub> = -4.5 Vdc,<br>R <sub>G</sub> = 6.0 Ω) | t <sub>d(on)</sub>  | - | 25  | 35  | ns |
| Rise Time           |  | t <sub>r</sub>      | - | 40  | 65  |    |
| Turn-Off Delay Time |  | t <sub>d(off)</sub> | - | 110 | 190 |    |
| Fall Time           |  | t <sub>f</sub>      | - | 110 | 190 |    |
| Turn-On Delay Time  | (V <sub>DD</sub> = -10 Vdc, I <sub>D</sub> = -10 Adc,<br>V <sub>GS</sub> = -4.5 Vdc,<br>R <sub>G</sub> = 6.0 Ω)  | t <sub>d(on)</sub>  | - | 25  | -   | ns |
| Rise Time           |  | t <sub>r</sub>      | - | 100 | -   |    |
| Turn-Off Delay Time |  | t <sub>d(off)</sub> | - | 100 | -   |    |
| Fall Time           |  | t <sub>f</sub>      | - | 125 | -   |    |
| Total Gate Charge   | (V <sub>DS</sub> = -10 Vdc,<br>V <sub>GS</sub> = -4.5 Vdc,<br>I <sub>D</sub> = -10 Adc)                          | Q <sub>tot</sub>    | - | 48  | 70  | nC |
| Gate-Source Charge  |  | Q <sub>gs</sub>     | - | 6.5 | -   |    |
| Gate-Drain Charge   |  | Q <sub>gd</sub>     | - | 17  | -   |    |

### BODY-DRAIN DIODE RATINGS (Note 5.)

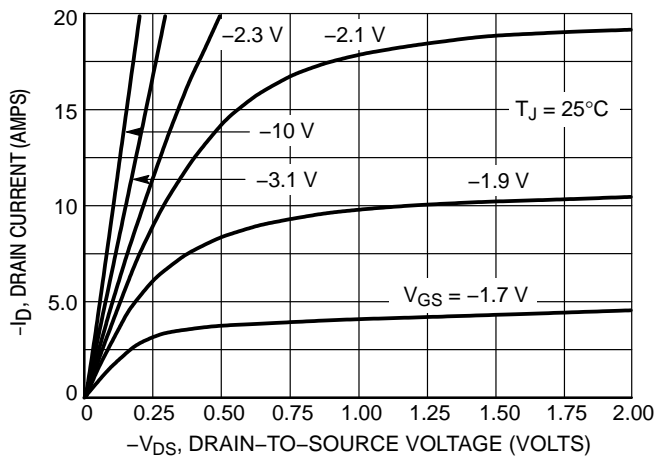
|                                |  |                 |        |                |           |     |
|--------------------------------|--|-----------------|--------|----------------|-----------|-----|
| Diode Forward On-Voltage       | (I <sub>S</sub> = -2.1 Adc, V <sub>GS</sub> = 0 Vdc)<br>(I <sub>S</sub> = -2.1 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C) | V <sub>SD</sub> | -<br>- | -0.72<br>-0.60 | -1.2<br>- | Vdc |
| Diode Forward On-Voltage       | (I <sub>S</sub> = -10 Adc, V <sub>GS</sub> = 0 Vdc)<br>(I <sub>S</sub> = -10 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C)   | V <sub>SD</sub> | -<br>- | -0.90<br>-0.75 | -<br>-    | Vdc |
| Reverse Recovery Time          | (I <sub>S</sub> = -2.1 Adc, V <sub>GS</sub> = 0 Vdc,<br>di/dt = 100 A/μs)  | t <sub>rr</sub> | -      | 65             | 100       | ns  |
|                                |  | t <sub>a</sub>  | -      | 25             | -         |     |
|                                |  | t <sub>b</sub>  | -      | 40             | -         |     |
| Reverse Recovery Stored Charge |  | Q <sub>RR</sub> | -      | 0.075          | -         | μC  |

4. Handling precautions to protect against electrostatic discharge is mandatory.

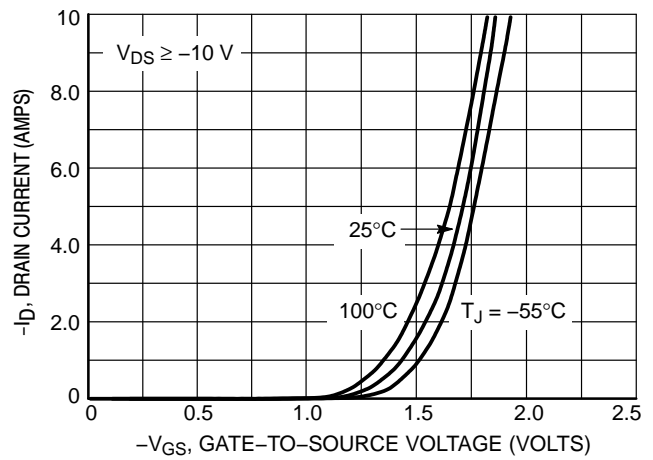
5. Indicates Pulse Test: Pulse Width = 300 μs max, Duty Cycle = 2%.

6. Switching characteristics are independent of operating junction temperature.

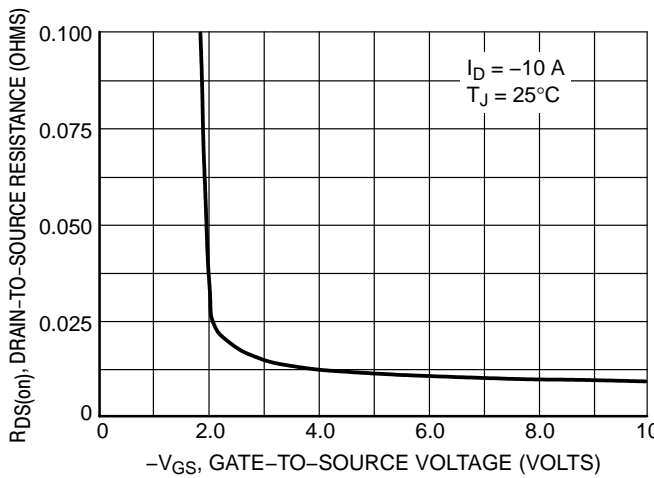
# NTMS10P02R2



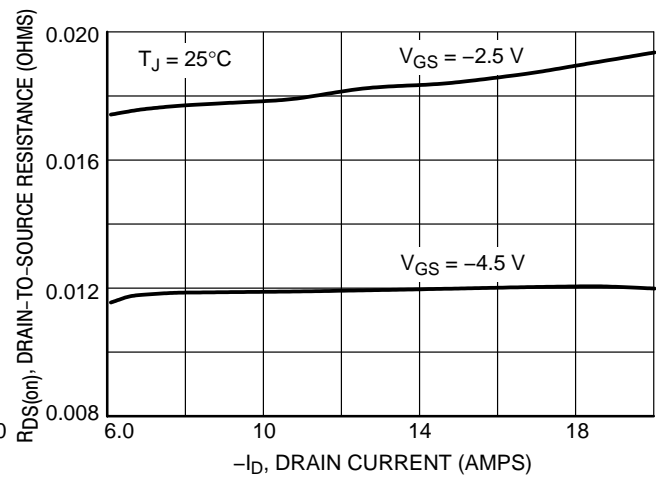
**Figure 1. On-Region Characteristics**



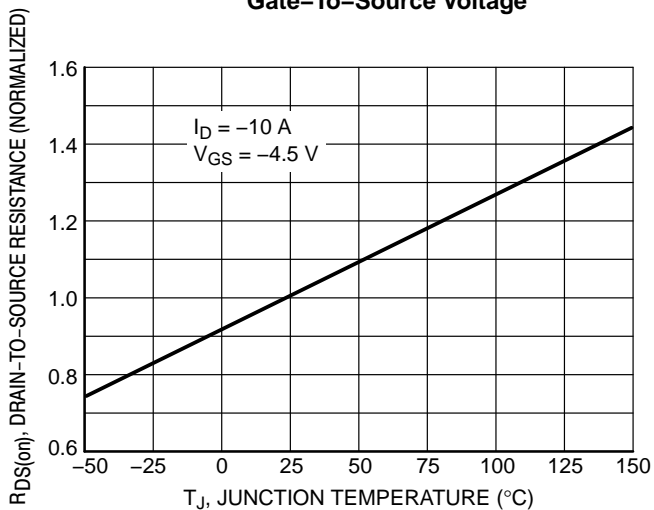
**Figure 2. Transfer Characteristics**



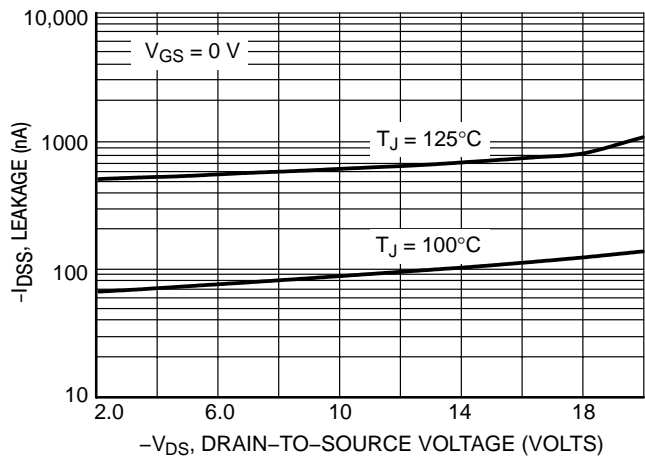
**Figure 3. On-Resistance versus Gate-To-Source Voltage**



**Figure 4. On-Resistance versus Drain Current and Gate Voltage**



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



**Figure 6. Drain-To-Source Leakage Current versus Voltage**

# NTMS10P02R2

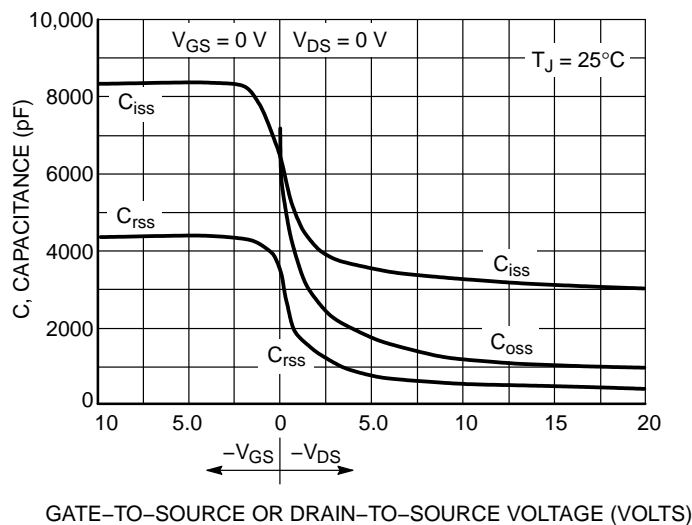


Figure 7. Capacitance Variation

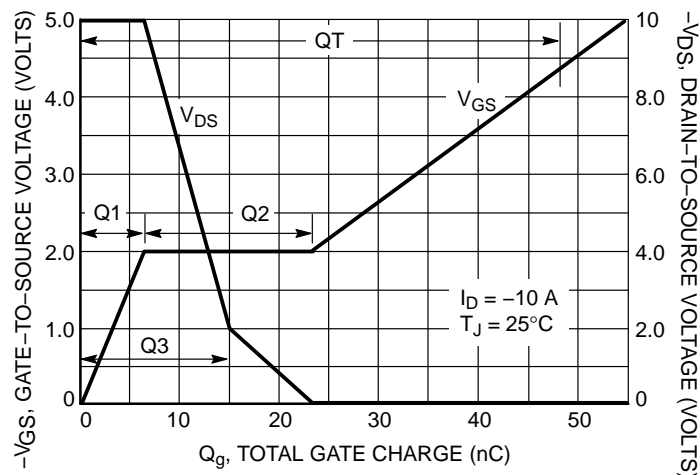


Figure 8. Gate-To-Source and Drain-To-Source Voltage versus Total Charge

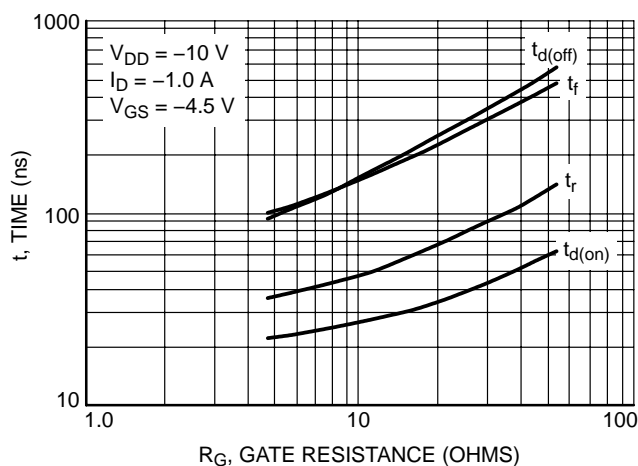


Figure 9. Resistive Switching Time Variation versus Gate Resistance

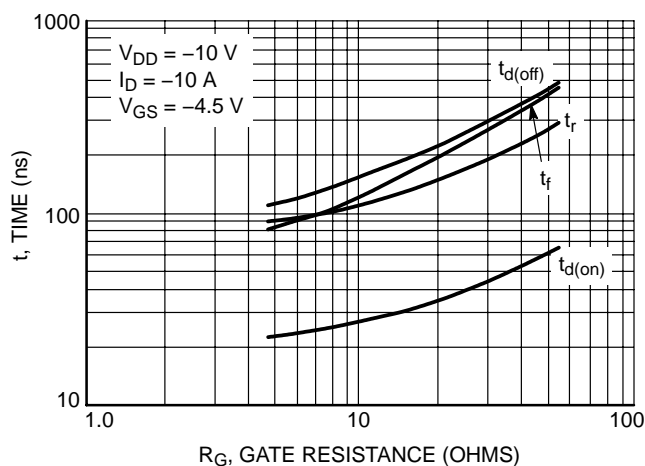


Figure 10. Resistive Switching Time Variation versus Gate Resistance

# DRAIN-TO-SOURCE DIODE CHARACTERISTICS

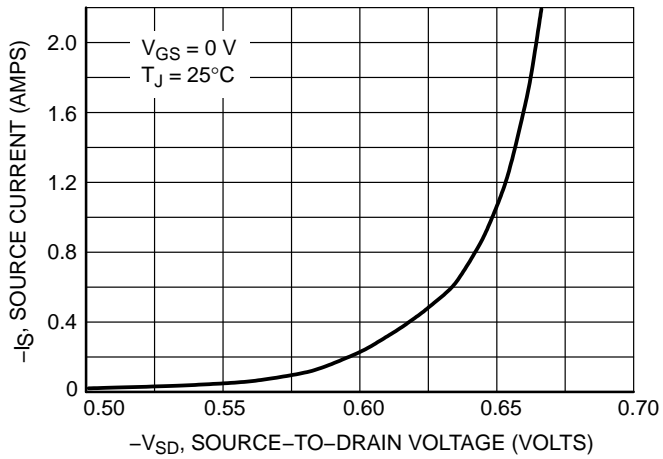


Figure 11. Diode Forward Voltage versus Current

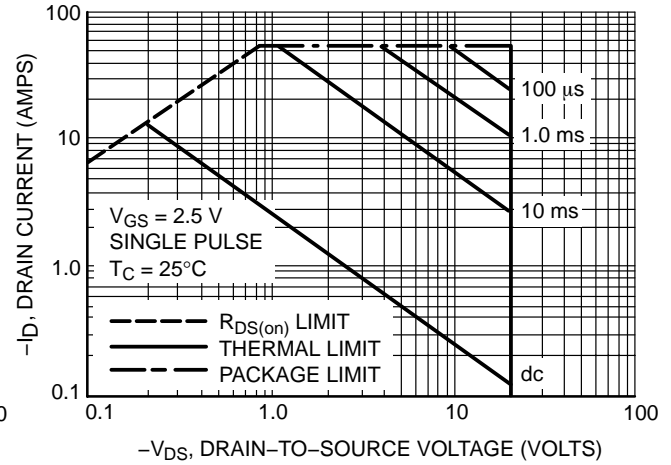


Figure 12. Maximum Rated Forward Biased Safe Operating Area

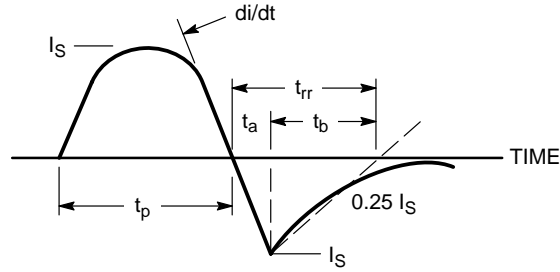


Figure 13. Diode Reverse Recovery Waveform

## TYPICAL ELECTRICAL CHARACTERISTICS

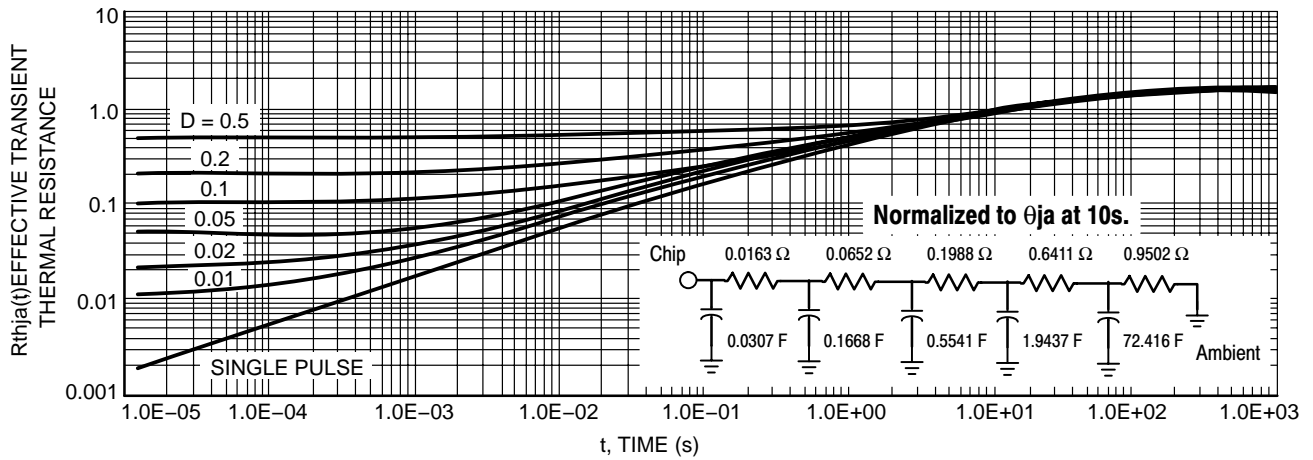
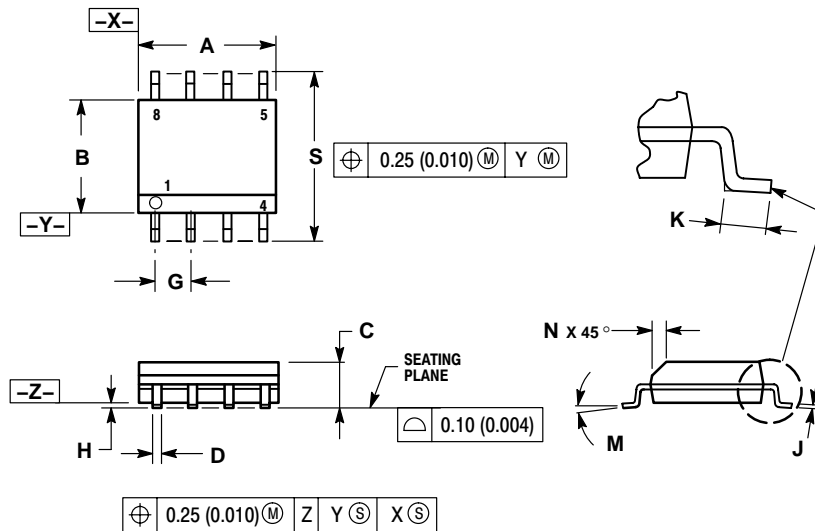


Figure 14. Thermal Response

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## PACKAGE DIMENSIONS

SO-8  
CASE 751-07  
ISSUE AA



### NOTES:

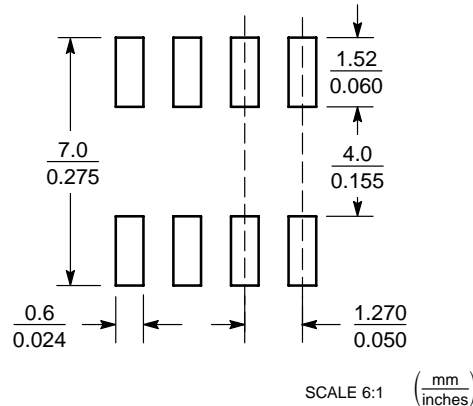
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL 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 |

### STYLE 12:

1. SOURCE
2. SOURCE
3. SOURCE
4. GATE
5. DRAIN
6. DRAIN
7. DRAIN
8. DRAIN

## SOLDERING FOOTPRINT\*



\*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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