

NTMD6N02R2

Power MOSFET 6.0 Amps, 20 Volts

N-Channel Enhancement Mode Dual SO-8 Package



ON Semiconductor®

<http://onsemi.com>

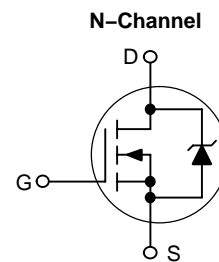
Features

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

Applications

- DC-DC Converters
- Low Voltage Motor Control
- Power Management in Portable and Battery-Powered Products, for example, Computers, Printers, Cellular and Cordless Telephones and PCMCIA Cards

| V_{DSS} | $R_{DS(ON)}$ TYP | I_D MAX |
|-----------|----------------------------------|-----------|
| 20 V | 35 m Ω @ $V_{GS} = 4.5$ V | 6.0 A |



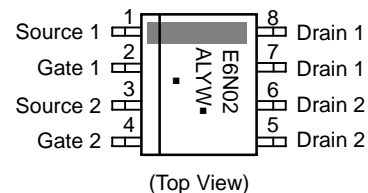
SOIC-8
CASE 751
STYLE 11

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

| Rating | Symbol | Value | Unit |
|---|-----------------|----------|--------------------|
| Drain-to-Source Voltage | V_{DSS} | 20 | V |
| Drain-to-Gate Voltage ($R_{GS} = 1.0$ M Ω) | V_{DGR} | 20 | V |
| Gate-to-Source Voltage - Continuous | V_{GS} | ± 12 | V |
| Thermal Resistance, Junction-to-Ambient (Note 1) | $R_{\theta JA}$ | 62.5 | $^\circ\text{C/W}$ |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$ | P_D | 2.0 | W |
| Continuous Drain Current @ $T_A = 25^\circ\text{C}$ | I_D | 6.5 | A |
| Continuous Drain Current @ $T_A = 70^\circ\text{C}$ | I_D | 5.5 | A |
| Pulsed Drain Current (Note 4) | I_{DM} | 50 | A |
| Thermal Resistance, Junction-to-Ambient (Note 2) | $R_{\theta JA}$ | 102 | $^\circ\text{C/W}$ |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$ | P_D | 1.22 | W |
| Continuous Drain Current @ $T_A = 25^\circ\text{C}$ | I_D | 5.07 | A |
| Continuous Drain Current @ $T_A = 70^\circ\text{C}$ | I_D | 4.07 | A |
| Pulsed Drain Current (Note 4) | I_{DM} | 40 | A |
| Thermal Resistance Junction-to-Ambient (Note 3) | $R_{\theta JA}$ | 172 | $^\circ\text{C/W}$ |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$ | P_D | 0.73 | W |
| Continuous Drain Current @ $T_A = 25^\circ\text{C}$ | I_D | 3.92 | A |
| Continuous Drain Current @ $T_A = 70^\circ\text{C}$ | I_D | 3.14 | A |
| Pulsed Drain Current (Note 4) | I_{DM} | 30 | A |

1. Mounted onto a 2 in square FR-4 Board (1 in sq. 2 oz. Cu 0.06 in thick single sided), $t < 10$ seconds.
2. Mounted onto a 2 in square FR-4 Board (1 in sq. 2 oz. Cu 0.06 in thick single sided), $t =$ steady state.
3. Minimum FR-4 or G-10 PCB, $t =$ steady state.
4. Pulse Test: Pulse Width = 10 μs , Duty Cycle = 2%.

MARKING DIAGRAM & PIN ASSIGNMENT



E6N02 = Specific 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† |
|-------------|---------------------|------------------|
| NTMD6N02R2 | SOIC-8 | 2500/Tape & Reel |
| NTMD6N02R2G | SOIC-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.

NTMD6N02R2

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

| Rating | Symbol | Value | Unit |
|---|----------------|-------------|------------------|
| Operating and Storage Temperature Range | T_J, T_{stg} | -55 to +150 | $^\circ\text{C}$ |
| Single Pulse Drain-to-Source Avalanche Energy – Starting $T_J = 25^\circ\text{C}$ ($V_{DD} = 20\text{ Vdc}$, $V_{GS} = 5.0\text{ Vdc}$, Peak $I_L = 6.0\text{ Apk}$, $L = 20\text{ mH}$, $R_G = 25\ \Omega$) | E_{AS} | 360 | mJ |
| Maximum Lead Temperature for Soldering Purposes for 10 seconds | T_L | 260 | $^\circ\text{C}$ |

ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted) (Note 5)

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

OFF CHARACTERISTICS

| | | | | | |
|--|---------------|---------|-----------|-----------|-----------------------------|
| Drain-to-Source Breakdown Voltage ($V_{GS} = 0\text{ Vdc}$, $I_D = 250\ \mu\text{Adc}$) Temperature Coefficient (Positive) | $V_{(BR)DSS}$ | 20 – | – 19.2 | – – | Vdc mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current ($V_{DS} = 20\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$, $T_J = 25^\circ\text{C}$) ($V_{DS} = 20\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$, $T_J = 125^\circ\text{C}$) | I_{DSS} | – – | – – | 1.0 10 | μAdc |
| Gate-Body Leakage Current ($V_{GS} = +12\text{ Vdc}$, $V_{DS} = 0\text{ Vdc}$) | I_{GSS} | – | – | 100 | nAdc |
| Gate-Body Leakage Current ($V_{GS} = -12\text{ Vdc}$, $V_{DS} = 0\text{ Vdc}$) | I_{GSS} | – | – | -100 | nAdc |

ON CHARACTERISTICS

| | | | | | |
|--|--------------|------------------|----------------------------------|----------------------------------|-----------------------------|
| Gate Threshold Voltage ($V_{DS} = V_{GS}$, $I_D = -250\ \mu\text{Adc}$) Temperature Coefficient (Negative) | $V_{GS(th)}$ | 0.6 – | 0.9 -3.0 | 1.2 – | Vdc mV/ $^\circ\text{C}$ |
| Static Drain-to-Source On-State Resistance ($V_{GS} = 4.5\text{ Vdc}$, $I_D = 6.0\text{ Adc}$) ($V_{GS} = 4.5\text{ Vdc}$, $I_D = 4.0\text{ Adc}$) ($V_{GS} = 2.7\text{ Vdc}$, $I_D = 2.0\text{ Adc}$) ($V_{GS} = 2.5\text{ Vdc}$, $I_D = 3.0\text{ Adc}$) | $R_{DS(on)}$ | – – – – | 0.028 0.028 0.033 0.035 | 0.035 0.043 0.048 0.049 | Ω |
| Forward Transconductance ($V_{DS} = 12\text{ Vdc}$, $I_D = 3.0\text{ Adc}$) | g_{FS} | – | 10 | – | Mhos |

DYNAMIC CHARACTERISTICS

| | | | | | | |
|------------------------------|---|-----------|---|-----|------|----|
| Input Capacitance | $(V_{DS} = 16\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$, $f = 1.0\text{ MHz}$) | C_{iss} | – | 785 | 1100 | pF |
| Output Capacitance | | C_{oss} | – | 260 | 450 | |
| Reverse Transfer Capacitance | | C_{rss} | – | 75 | 180 | |

SWITCHING CHARACTERISTICS (Notes 6 and 7)

| | | | | | | |
|---------------------|--|--------------|---|-----|-----|----|
| Turn-On Delay Time | $(V_{DD} = 16\text{ Vdc}$, $I_D = 6.0\text{ Adc}$, $V_{GS} = 4.5\text{ Vdc}$, $R_G = 6.0\ \Omega$) | $t_{d(on)}$ | – | 12 | 20 | ns |
| Rise Time | | t_r | – | 50 | 90 | |
| Turn-Off Delay Time | | $t_{d(off)}$ | – | 45 | 75 | |
| Fall Time | | t_f | – | 80 | 130 | |
| Turn-On Delay Time | $(V_{DD} = 16\text{ Vdc}$, $I_D = 4.0\text{ Adc}$, $V_{GS} = 4.5\text{ Vdc}$, $R_G = 6.0\ \Omega$) | $t_{d(on)}$ | – | 11 | 18 | ns |
| Rise Time | | t_r | – | 35 | 65 | |
| Turn-Off Delay Time | | $t_{d(off)}$ | – | 45 | 75 | |
| Fall Time | | t_f | – | 60 | 110 | |
| Total Gate Charge | $(V_{DS} = 16\text{ Vdc}$, $V_{GS} = 4.5\text{ Vdc}$, $I_D = 6.0\text{ Adc}$) | Q_{tot} | – | 12 | 20 | nC |
| Gate-Source Charge | | Q_{gs} | – | 1.5 | – | |
| Gate-Drain Charge | | Q_{gd} | – | 4.0 | – | |

5. Handling precautions to protect against electrostatic discharge is mandatory
6. Indicates Pulse Test: Pulse Width = 300 μs max, Duty Cycle = 2%.
7. Switching characteristics are independent of operating junction temperature.

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ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted) (continued) (Note 8)

| Characteristic | Symbol | Min | Typ | Max | Unit | |
|--|----------|-----|--|-------|---------------|----|
| BODY-DRAIN DIODE RATINGS (Note 9) | | | | | | |
| Diode Forward On-Voltage | V_{SD} | - | $(I_S = 4.0 \text{ Adc}, V_{GS} = 0 \text{ Vdc})$ | 0.83 | Vdc | |
| | | | $(I_S = 6.0 \text{ Adc}, V_{GS} = 0 \text{ Vdc})$ | 0.88 | | |
| | | | $(I_S = 6.0 \text{ Adc}, V_{GS} = 0 \text{ Vdc}, T_J = 125^\circ\text{C})$ | 0.75 | | |
| Reverse Recovery Time | t_{rr} | - | $(I_S = 6.0 \text{ Adc}, V_{GS} = 0 \text{ Vdc}, dI_S/dt = 100 \text{ A}/\mu\text{s})$ | 30 | ns | |
| | | | | t_a | | 15 |
| | | | | t_b | | 15 |
| Reverse Recovery Stored Charge | Q_{RR} | - | 0.02 | - | μC | |

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

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

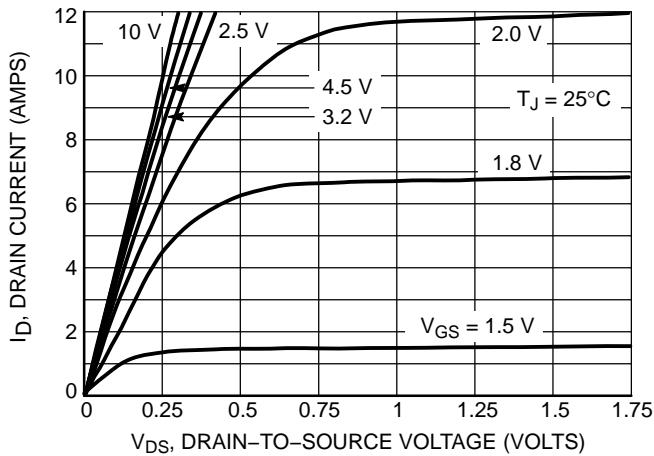


Figure 1. On-Region Characteristics

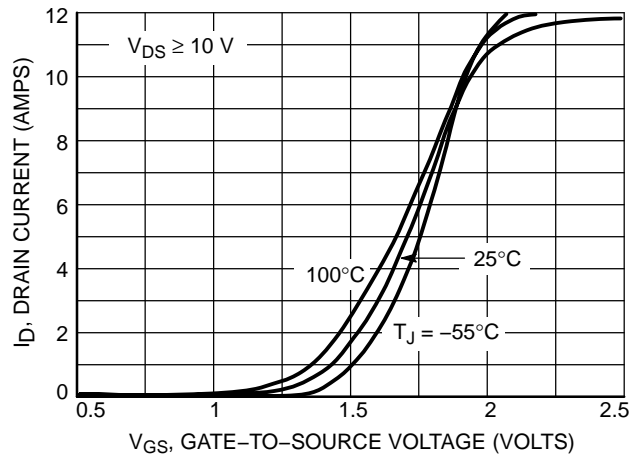


Figure 2. Transfer Characteristics

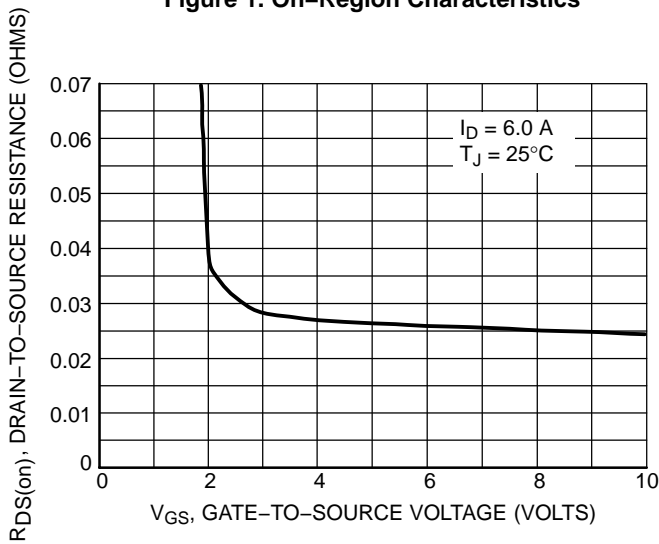


Figure 3. On-Resistance versus Gate-to-Source Voltage

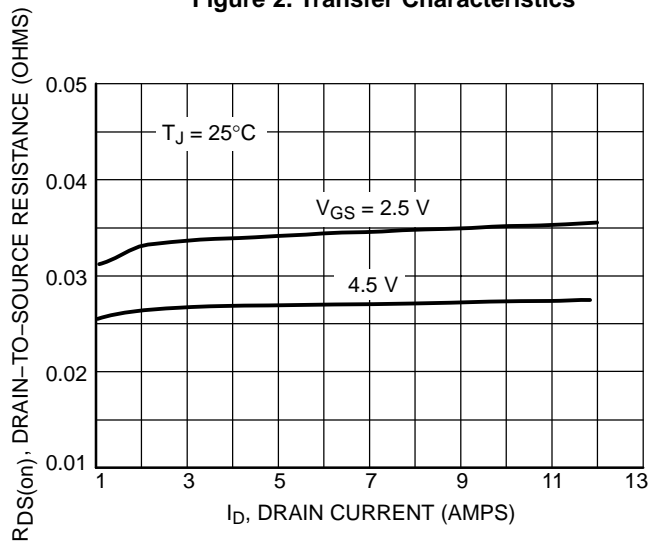


Figure 4. On-Resistance versus Drain Current and Gate Voltage

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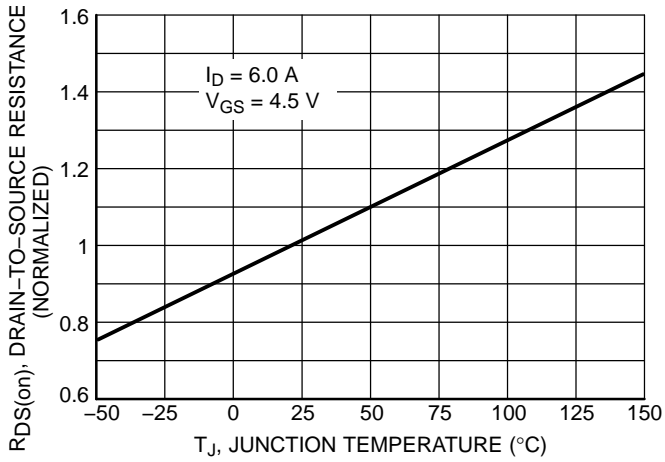


Figure 5. On-Resistance Variation with Temperature

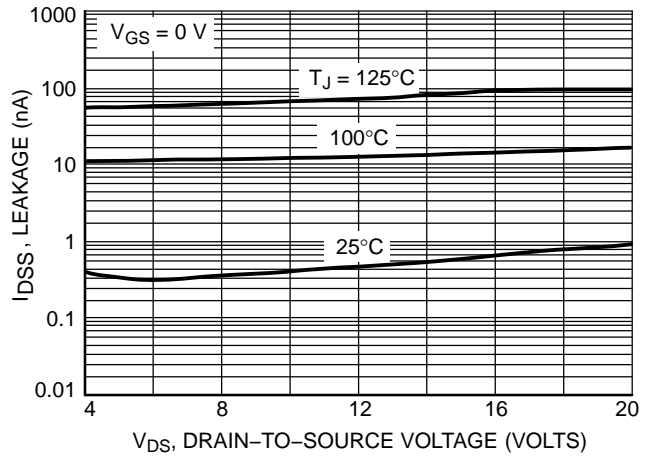


Figure 6. Drain-To-Source Leakage Current versus Voltage

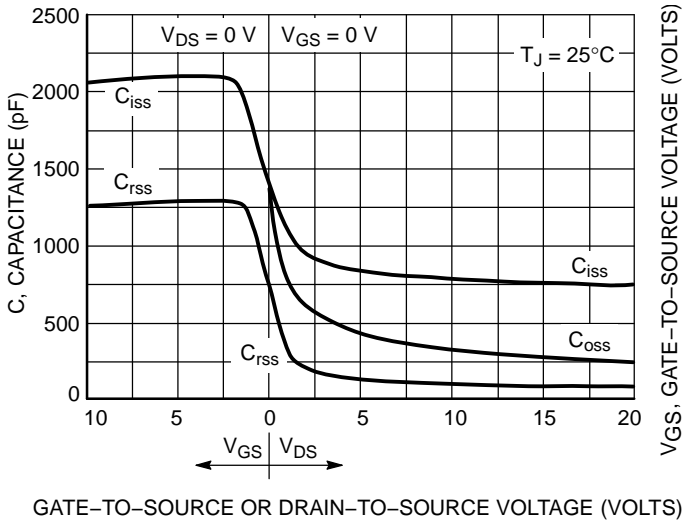


Figure 7. Capacitance Variation

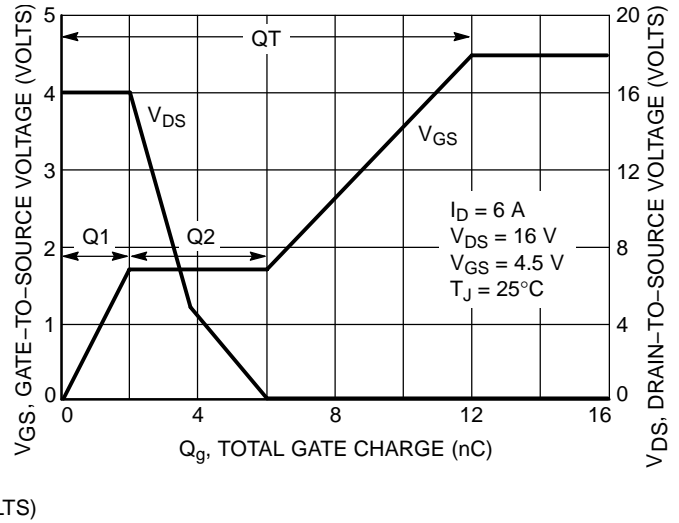


Figure 8. Gate-To-Source and Drain-To-Source Voltage versus Total Charge

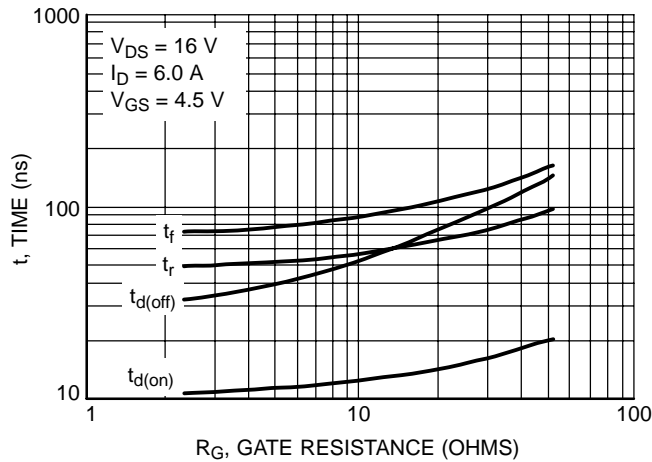


Figure 9. Resistive Switching Time Variation versus Gate Resistance

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DRAIN-TO-SOURCE DIODE CHARACTERISTICS

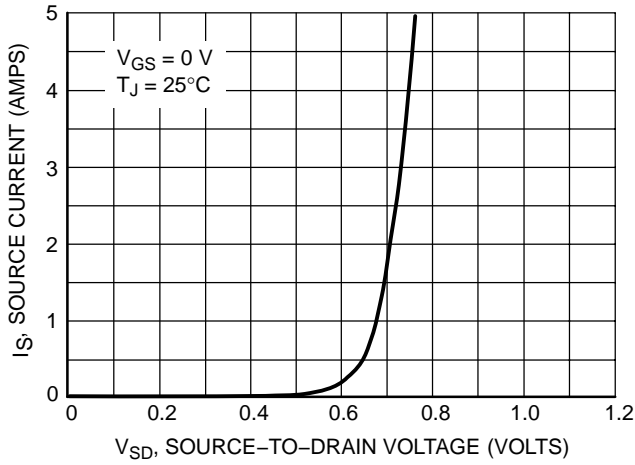


Figure 10. Diode Forward Voltage versus Current

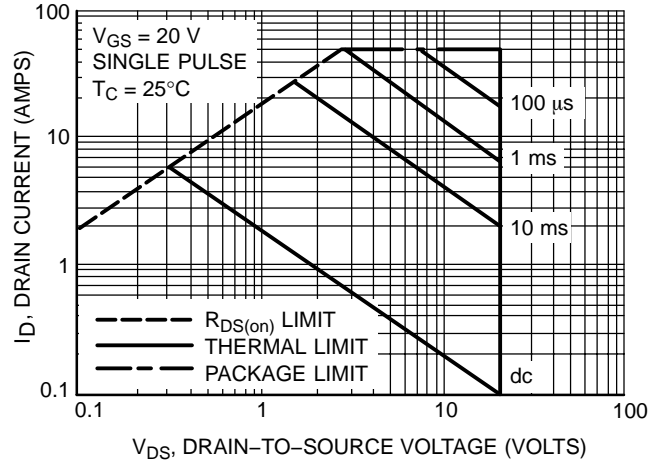


Figure 11. Maximum Rated Forward Biased Safe Operating Area

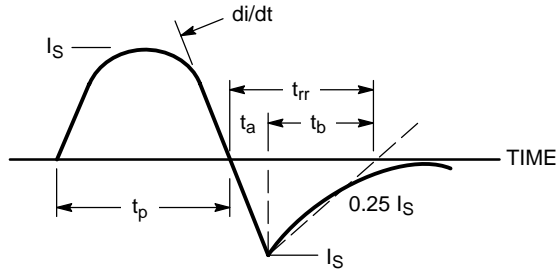


Figure 12. Diode Reverse Recovery Waveform

TYPICAL ELECTRICAL CHARACTERISTICS

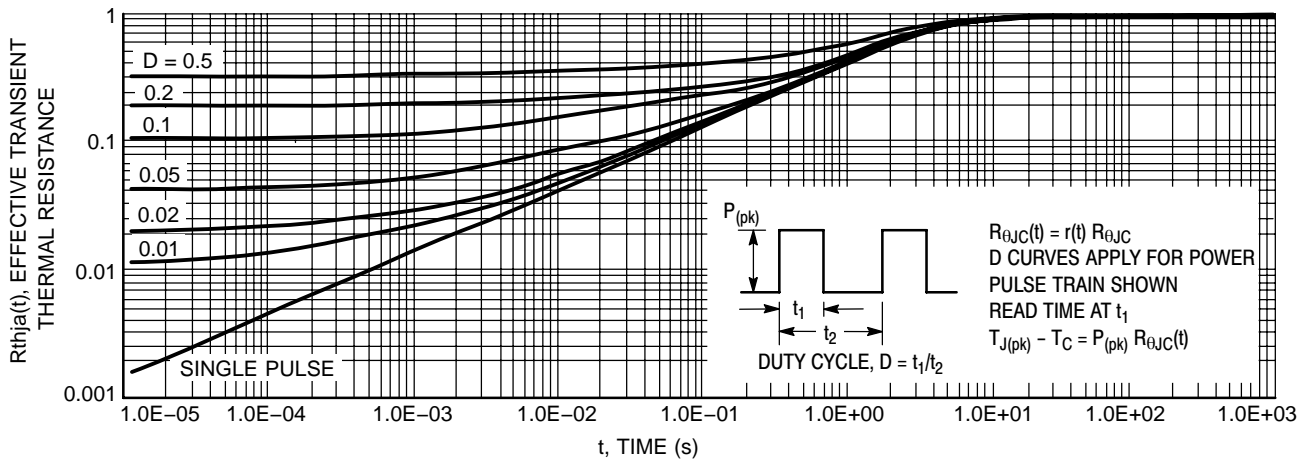
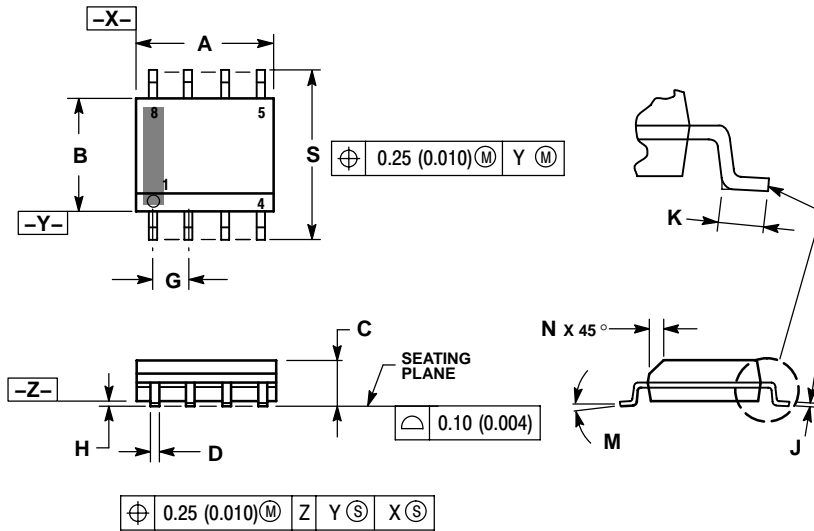


Figure 13. Thermal Response

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PACKAGE DIMENSIONS

SOIC-8
CASE 751-07
ISSUE AG



NOTES:

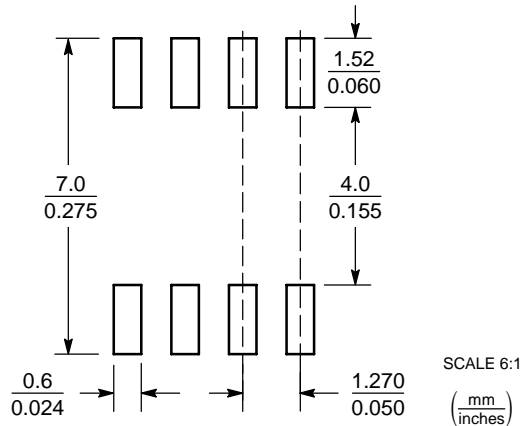
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL 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 11:

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

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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