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# NTMS5P02, NVMS5P02

# Power MOSFET
# -5.4 Amps, -20 Volts

## P−Channel Enhancement−Mode
## Single SOIC−8 Package

ON Semiconductor®

http://onsemi.com

| $V_{DSS}$ | $R_{DS(ON)}$ TYP | $I_D$ MAX |
|---|---|---|
| −20 V | 26 mΩ @ −4.5 V | −5.4 A |

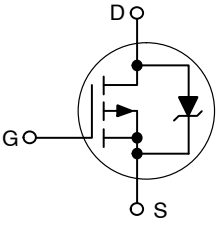
### Features

- High Density Power MOSFET with Ultra Low $R_{DS(on)}$ Providing Higher Efficiency
- Miniature SOIC−8 Surface Mount Package − Saves Board Space
- Diode Exhibits High Speed with Soft Recovery
- $I_{DSS}$ Specified at Elevated Temperature
- Drain−to−Source Avalanche Energy Specified
- Mounting Information for the SOIC−8 Package is Provided
- These Devices are Pb−Free and are RoHS Compliant
- NVMS Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q101 Qualified and PPAP Capable

### Applications

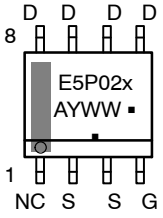
- Power Management in Portable and Battery−Powered Products, i.e.: Computers, Printers, PCMCIA Cards, Cellular & Cordless Telephones

**Single P−Channel**




**MARKING DIAGRAM & PIN ASSIGNMENT**


**SOIC−8**
**CASE 751**
**STYLE 13**




E5P02 = Specific Device Code
x = Blank or S
A = Assembly Location
Y = Year
WW = Work Week
▪ = Pb−Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device | Package | Shipping† |
|---|---|---|
| NTMS5P02R2G | SOIC−8 (Pb−Free) | 2500 / Tape & Reel |
| NVMS5P02R2G | 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 Specifications Brochure, BRD8011/D

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

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Drain−to−Source Voltage | $V_{DSS}$ | −20 | V |
| Drain−to−Gate Voltage ($R_{GS}$ = 1.0 mΩ) | $V_{DGR}$ | −20 | V |
| Gate−to−Source Voltage − Continuous | $V_{GS}$ | ±10 | V |
| Thermal Resistance − | | | |
| Junction−to−Ambient (Note 1) | $R_{\theta JA}$ | 50 | °C/W |
| Total Power Dissipation @ $T_A$ = 25°C | $P_D$ | 2.5 | W |
| Continuous Drain Current @ 25°C | $I_D$ | −7.05 | A |
| Continuous Drain Current @ 70°C | $I_D$ | −5.62 | A |
| Maximum Operating Power Dissipation | $P_D$ | 1.2 | W |
| Maximum Operating Drain Current | $I_D$ | −4.85 | A |
| Pulsed Drain Current (Note 4) | $I_{DM}$ | −28 | A |
| Thermal Resistance − | | | |
| Junction−to−Ambient (Note 2) | $R_{\theta JA}$ | 85 | °C/W |
| Total Power Dissipation @ $T_A$ = 25°C | $P_D$ | 1.47 | W |
| Continuous Drain Current @ 25°C | $I_D$ | −5.40 | A |
| Continuous Drain Current @ 70°C | $I_D$ | −4.30 | A |
| Maximum Operating Power Dissipation | $P_D$ | 0.7 | W |
| Maximum Operating Drain Current | $I_D$ | −3.72 | A |
| Pulsed Drain Current (Note 4) | $I_{DM}$ | −20 | A |
| Thermal Resistance − | | | |
| Junction−to−Ambient (Note 3) | $R_{\theta JA}$ | 159 | °C/W |
| Total Power Dissipation @ $T_A$ = 25°C | $P_D$ | 0.79 | W |
| Continuous Drain Current @ 25°C | $I_D$ | −3.95 | A |
| Continuous Drain Current @ 70°C | $I_D$ | −3.15 | A |
| Maximum Operating Power Dissipation | $P_D$ | 0.38 | W |
| Maximum Operating Drain Current | $I_D$ | −2.75 | A |
| Pulsed Drain Current (Note 4) | $I_{DM}$ | −12 | A |
| Operating and Storage Temperature Range | $T_J$, $T_{stg}$ | −55 to +150 | °C |
| Single Pulse Drain−to−Source Avalanche Energy − Starting $T_J$ = 25°C ($V_{DD}$ = −20 Vdc, $V_{GS}$ = −5.0 Vdc, Peak $I_L$ = −8.5 Apk, L = 10 mH, $R_G$ = 25 Ω) | $E_{AS}$ | 360 | mJ |
| Maximum Lead Temperature for Soldering Purposes, 1/8″ from case for 10 seconds | $T_L$ | 260 | °C |

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. Mounted onto a 2″ square FR−4 Board (1″ sq. 2 oz Cu 0.06″ thick single sided), t ≤ 10 seconds.
2. Mounted onto a 2″ square FR−4 Board (1″ sq. 2 oz Cu 0.06″ thick single sided), t = steady state.
3. Minimum FR−4 or G−10 PCB, t = Steady State.
4. Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2%.

**ELECTRICAL CHARACTERISTICS** ($T_C$ = 25°C unless otherwise noted) (Note 5)

| Characteristic | | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| Drain−to−Source Breakdown Voltage<br>($V_{GS}$ = 0 Vdc, $I_D$ = −250 μAdc)<br>Temperature Coefficient (Positive) | | $V_{(BR)DSS}$ | <br>−20<br>− | <br>−<br>−15 | <br>−<br>− | Vdc<br><br>mV/°C |
| Zero Gate Voltage Drain Current<br>($V_{DS}$ = −16 Vdc, $V_{GS}$ = 0 Vdc, $T_J$ = 25°C)<br>($V_{DS}$ = −16 Vdc, $V_{GS}$ = 0 Vdc, $T_J$ = 125°C)<br>($V_{DS}$ = −20 Vdc, $V_{GS}$ = 0 Vdc, $T_J$ = 25°C) | | $I_{DSS}$ | <br>−<br>−<br>− | <br>−<br>−<br>−0.2 | <br>−1.0<br>−10<br>− | μAdc |
| Gate−Body Leakage Current<br>($V_{GS}$ = −10 Vdc, $V_{DS}$ = 0 Vdc) | | $I_{GSS}$ | <br>− | <br>− | <br>−100 | nAdc |
| Gate−Body Leakage Current<br>($V_{GS}$ = +10 Vdc, $V_{DS}$ = 0 Vdc) | | $I_{GSS}$ | <br>− | <br>− | <br>100 | nAdc |
| **ON CHARACTERISTICS** | | | | | | |
| Gate Threshold Voltage<br>($V_{DS}$ = $V_{GS}$, $I_D$ = −250 μAdc)<br>Temperature Coefficient (Negative) | | $V_{GS(th)}$ | <br>−0.65<br>− | <br>−0.9<br>2.9 | <br>−1.25<br>− | Vdc<br><br>mV/°C |
| Static Drain−to−Source On−State Resistance<br>($V_{GS}$ = −4.5 Vdc, $I_D$ = −5.4 Adc)<br>($V_{GS}$ = −2.5 Vdc, $I_D$ = −2.7 Adc) | | $R_{DS(on)}$ | <br>−<br>− | <br>0.026<br>0.037 | <br>0.033<br>0.048 | Ω |
| Forward Transconductance ($V_{DS}$ = −9.0 Vdc, $I_D$ = −5.4 Adc) | | $g_{FS}$ | − | 15 | − | Mhos |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| Input Capacitance | ($V_{DS}$ = −16 Vdc, $V_{GS}$ = 0 Vdc, f = 1.0 MHz) | $C_{iss}$ | − | 1375 | 1900 | pF |
| Output Capacitance | | $C_{oss}$ | − | 510 | 900 | |
| Reverse Transfer Capacitance | | $C_{rss}$ | − | 200 | 380 | |
| **SWITCHING CHARACTERISTICS** (Notes 6 & 7) | | | | | | |
| Turn−On Delay Time | ($V_{DD}$ = −16 Vdc, $I_D$ = −1.0 Adc, $V_{GS}$ = −4.5 Vdc, $R_G$ = 6.0 Ω) | $t_{d(on)}$ | − | 18 | 35 | ns |
| Rise Time | | $t_r$ | − | 25 | 50 | |
| Turn−Off Delay Time | | $t_{d(off)}$ | − | 70 | 125 | |
| Fall Time | | $t_f$ | − | 55 | 100 | |
| Turn−On Delay Time | ($V_{DD}$ = −16 Vdc, $I_D$ = −5.4 Adc, $V_{GS}$ = −4.5 Vdc, $R_G$ = 6.0 Ω) | $t_{d(on)}$ | − | 22 | − | ns |
| Rise Time | | $t_r$ | − | 70 | − | |
| Turn−Off Delay Time | | $t_{d(off)}$ | − | 65 | − | |
| Fall Time | | $t_f$ | − | 90 | − | |
| Total Gate Charge | ($V_{DS}$ = −16 Vdc, $V_{GS}$ = −4.5 Vdc, $I_D$ = −5.4 Adc) | $Q_{tot}$ | − | 20 | 35 | nC |
| Gate−Source Charge | | $Q_{gs}$ | − | 4.0 | − | |
| Gate−Drain Charge | | $Q_{gd}$ | − | 7.0 | − | |
| **BODY−DRAIN DIODE RATINGS** (Note 6) | | | | | | |
| Diode Forward On−Voltage | ($I_S$ = −5.4 Adc, $V_{GS}$ = 0 V)<br>($I_S$ = −5.4 Adc, $V_{GS}$ = 0 Vdc, $T_J$ = 125°C) | $V_{SD}$ | −<br>− | −0.95<br>−0.72 | −1.25<br>− | Vdc |
| Reverse Recovery Time | ($I_S$ = −5.4 Adc, $V_{GS}$ = 0 Vdc, $dI_S/dt$ = 100 A/μs) | $t_{rr}$ | − | 40 | 75 | ns |
| | | $t_a$ | − | 20 | − | |
| | | $t_b$ | − | 20 | − | |
| Reverse Recovery Stored Charge | | $Q_{RR}$ | − | 0.03 | − | μC |

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.

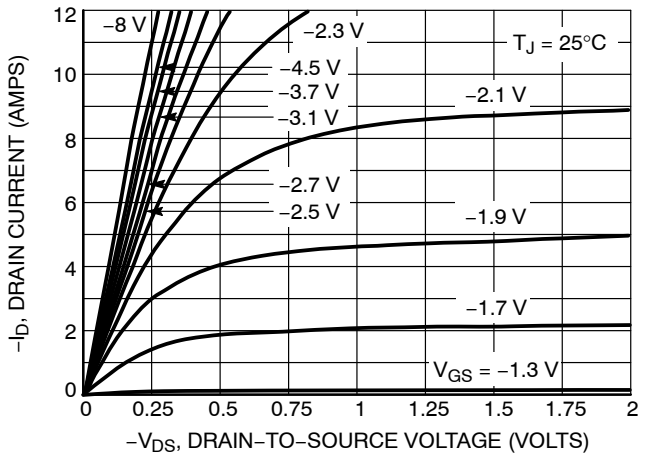



**Figure 1. On−Region Characteristics**

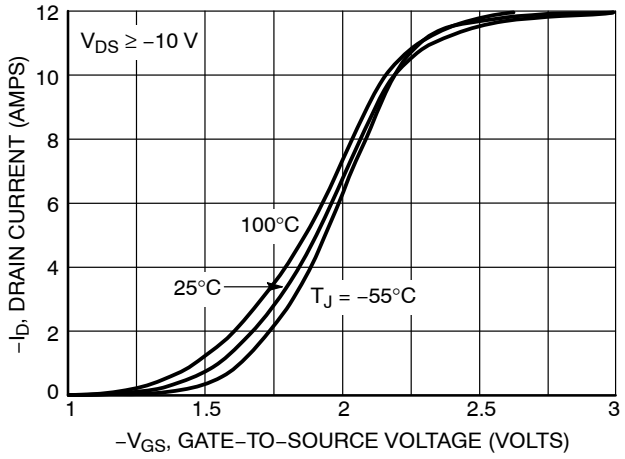



**Figure 2. Transfer Characteristics**

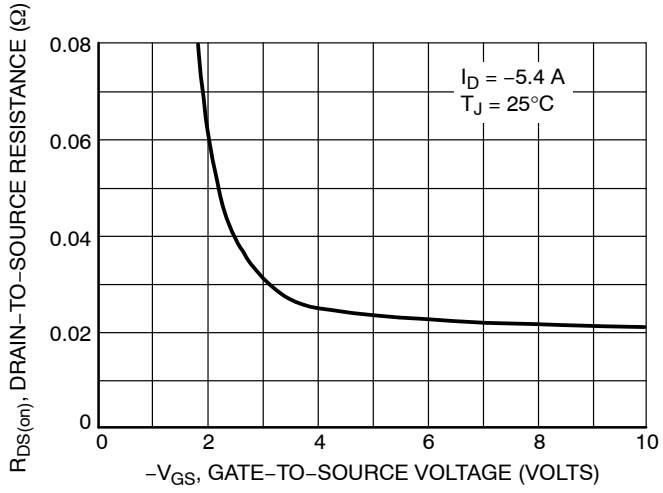



**Figure 3. On−Resistance versus Gate−To−Source Voltage**

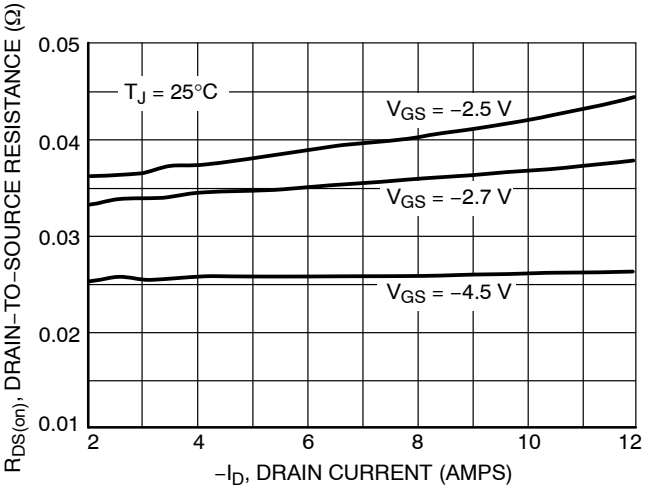



**Figure 4. On-Resistance versus Drain Current and Gate Voltage**

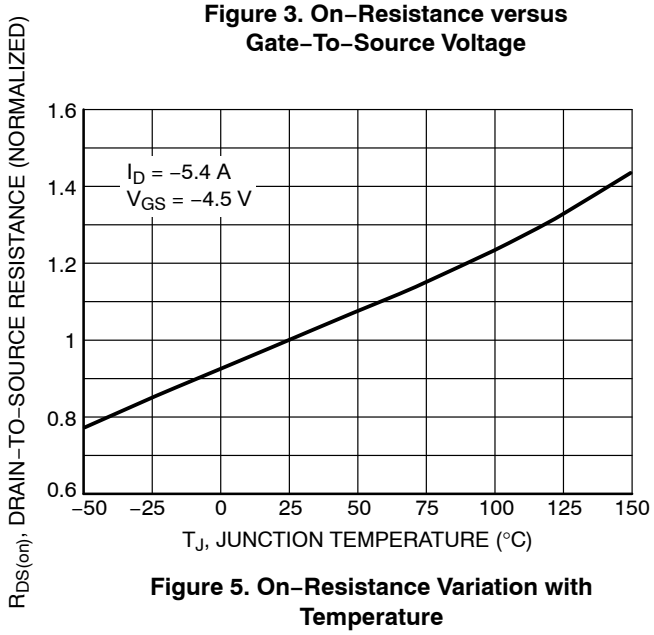



**Figure 5. On−Resistance Variation with Temperature**

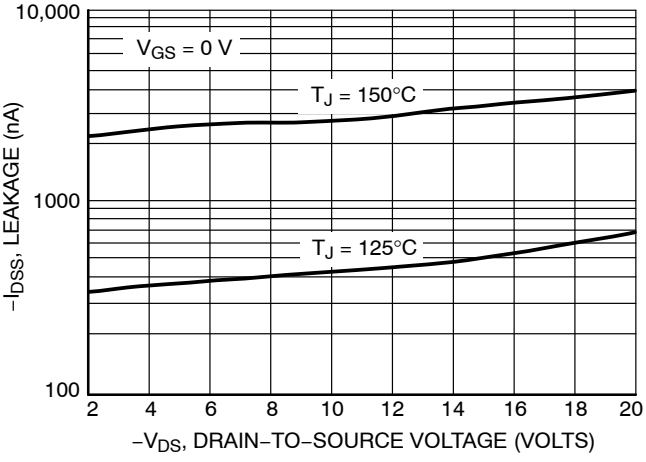



**Figure 6. Drain−To−Source Leakage Current versus Voltage**

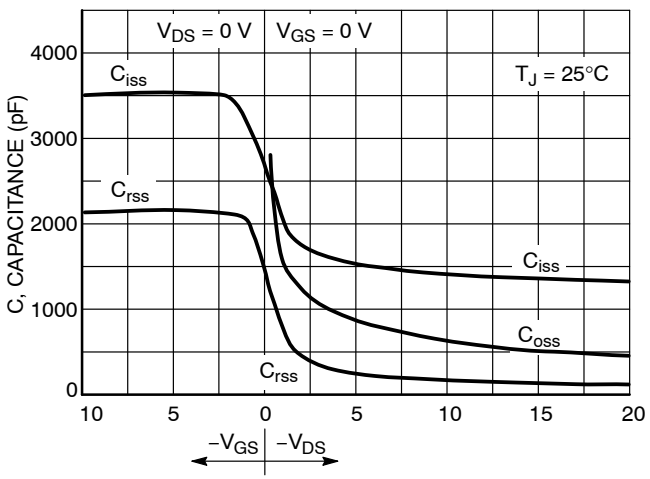



**Figure 7. Capacitance Variation**

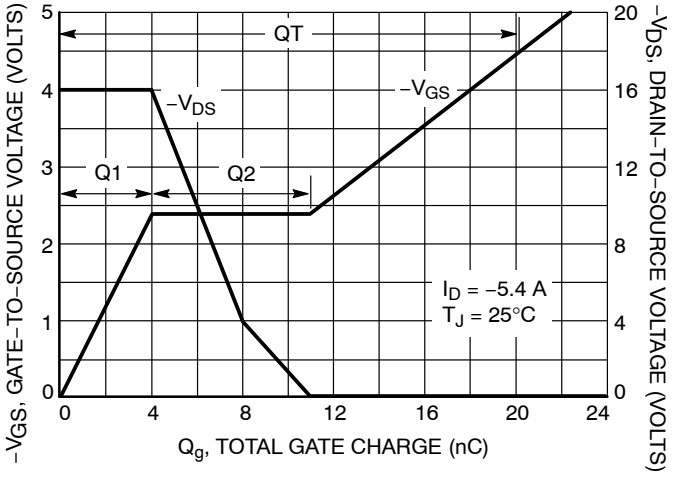



**Figure 8. Gate−To−Source and Drain−To−Source Voltage versus Total Charge**

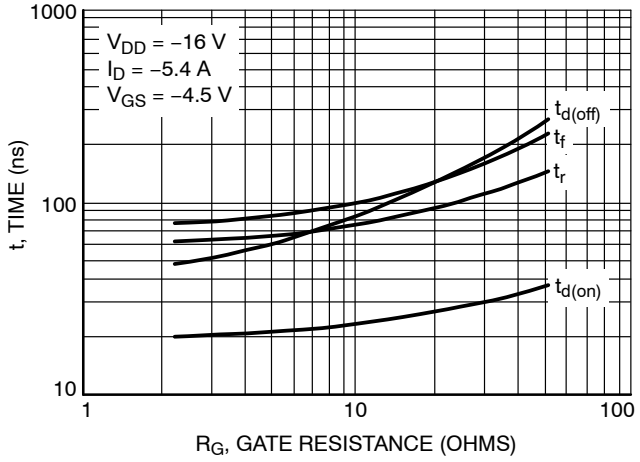



**Figure 9. Resistive Switching Time Variation versus Gate Resistance**

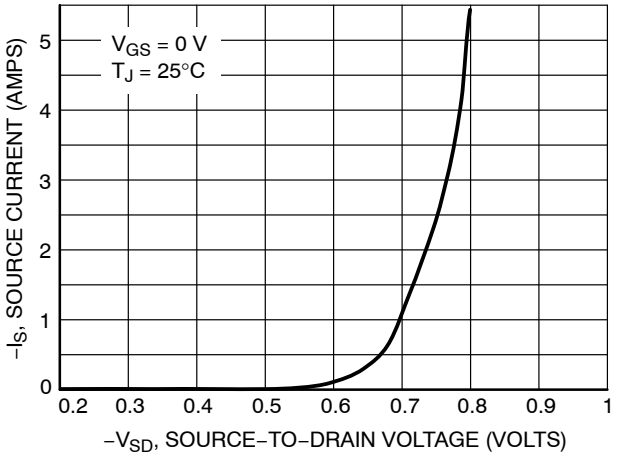



**Figure 10. Diode Forward Voltage versus Current**

## DRAIN−TO−SOURCE DIODE CHARACTERISTICS

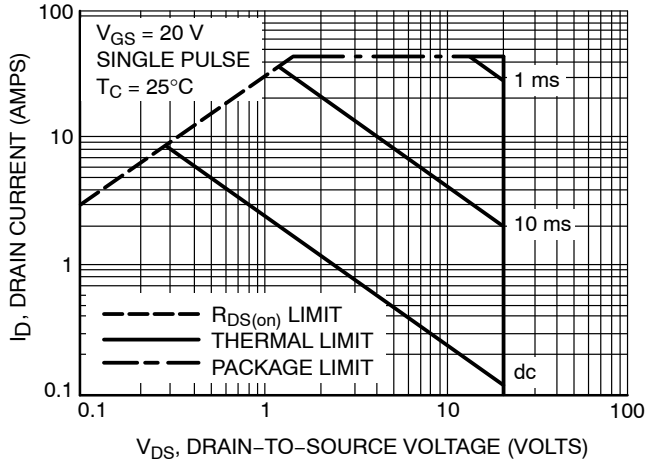



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

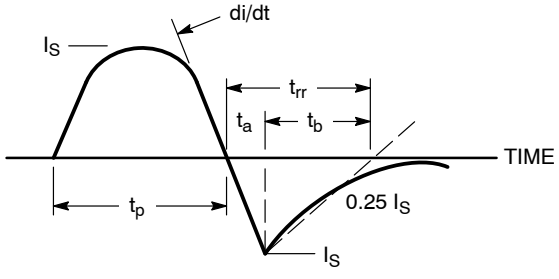



**Figure 12. Diode Reverse Recovery Waveform**

## TYPICAL ELECTRICAL CHARACTERISTICS

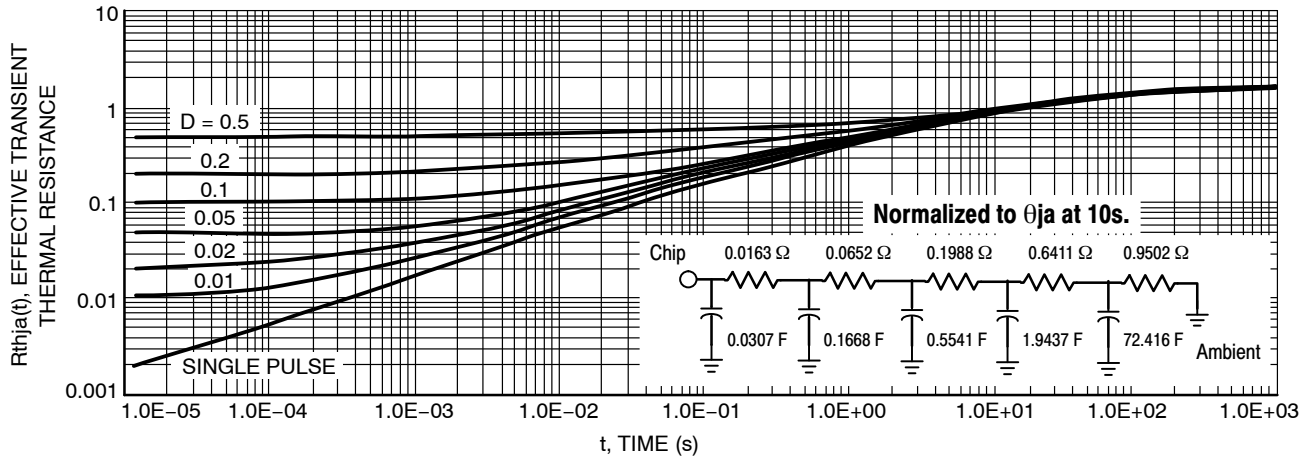
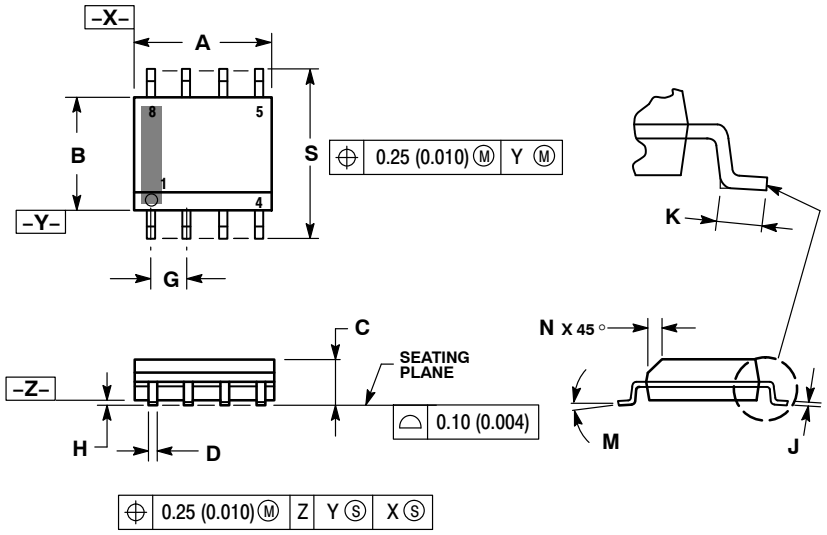



**Figure 13. Thermal Response**

## PACKAGE DIMENSIONS

**SOIC−8 NB**
CASE 751−07
ISSUE AK

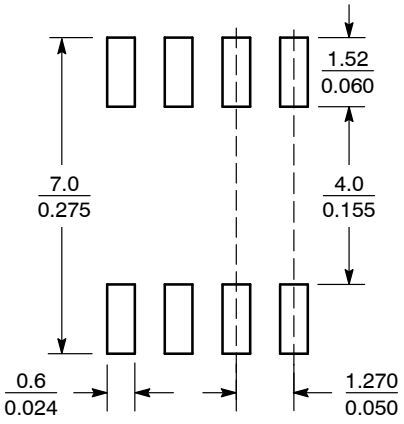



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005)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

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | 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 13:
PIN 1. N.C.
2. SOURCE
3. SOURCE
4. GATE
5. DRAIN
6. DRAIN
7. DRAIN
8. DRAIN

### SOLDERING FOOTPRINT*




SCALE 6:1 $\left(\frac{\text{mm}}{\text{inches}}\right)$

*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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