# NTMD6601NR2G

# Power MOSFET

## 80 V, 2.2 A, Dual 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
- Dual SO−8 Surface Mount Package Saves Board Space
- This is a Pb−Free Device

### Applications

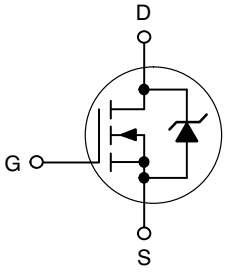
- LCD Displays

**ON Semiconductor®**

**http://onsemi.com**

| $V_{(BR)DSS}$ | $R_{DS(on)}$ Max | $I_D$ Max |
|---|---|---|
| 80 V | 215 mΩ @ 10 V | 2.2 A |
| | 245 mΩ @ 4.5 V | |

**N−Channel**




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

| Rating | | | Symbol | Value | Unit |
|---|---|---|---|---|---|
| Drain−to−Source Voltage | | | $V_{DSS}$ | 80 | V |
| Gate−to−Source Voltage − Continuous | | | $V_{GS}$ | ±15 | V |
| Continuous Drain Current $R_{\theta JA}$ (Note 1) | Steady State | $T_A$ = 25°C | $I_D$ | 1.4 | A |
| | | $T_A$ = 70°C | | 1.2 | |
| Power Dissipation $R_{\theta JA}$ (Note 1) | | $T_A$ = 25°C | $P_D$ | 1.0 | W |
| Continuous Drain Current $R_{\theta JA}$ (Note 2) | | $T_A$ = 25°C | $I_D$ | 1.1 | A |
| | | $T_A$ = 70°C | | 0.9 | |
| Power Dissipation $R_{\theta JA}$ (Note 2) | | $T_A$ = 25°C | $P_D$ | 0.6 | W |
| Continuous Drain Current $R_{\theta JA}$ t < 5 s (Note 1) | | $T_A$ = 25°C | $I_D$ | 2.2 | A |
| | | $T_A$ = 70°C | | 1.7 | |
| Pulsed Drain Current | $T_A$ = 25°C, $t_p$ = 10 μs | | $I_{DM}$ | 9.0 | A |
| Operating Junction and Storage Temperature | | | $T_J$, $T_{STG}$ | −55 to +150 | °C |
| Source Current (Body Diode) | | | $I_S$ | 1.3 | A |
| Single Pulse Drain−to−Source Avalanche Energy $T_J$ = 25C, $V_{DD}$ = 50 V, $V_{GS}$ = 10 V, $I_L$ = 7.0 $A_{pk}$, L = 1.0 mH, $R_G$ = 25 Ω | | | EAS | 2 5 | mJ |
| Lead Temperature for Soldering Purposes (1/8″ from case for 10 s) | | | $T_L$ | 260 | °C |

**THERMAL RESISTANCE RATINGS**

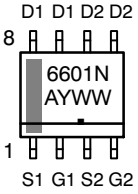
| Rating | Symbol | Max | Unit |
|---|---|---|---|
| Junction−to−Ambient – Steady State (Note 1) | $R_{\theta JA}$ | 120 | °C/W |
| Junction−to−Ambient – t≤ 5 s (Note 1) | $R_{\theta JA}$ | 48 | |
| Junction−to−FOOT (Drain) | $R_{\theta JF}$ | 40 | |
| Junction−to−Ambient – Steady State (Note 2) | $R_{\theta JA}$ | 200 | |

1. Surface−mounted on 2 inch sq FR4 board using 1 inch sq pad size, 1 oz Cu.
2. Surface−mounted on FR4 board using the minimum recommended pad size.

**MARKING DIAGRAM & PIN ASSIGNMENT**




**SO−8**
**CASE 751**
**STYLE 11**




6601N = Device Code
A = Assembly Location
Y = Year
WW = Work Week
▪ = Pb−Free Package

**ORDERING INFORMATION**

| Device | Package | Shipping† |
|---|---|---|
| NTMD6601NR2G | 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.

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**ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise noted)

| Characteristic | Symbol | Test Condition | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | | |
| Drain−to−Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 μA | | 80 | | | V |
| Drain−to−Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | | | | 99.8 | | mV/°C |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 80 V | $T_J$ = 25°C | | | 1.0 | μA |
| | | | $T_J$ = 125°C | | | 25 | |
| Gate−to−Source Leakage Current | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ±15 V | | | | ±100 | nA |
| **ON CHARACTERISTICS** (Note 3) | | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | | 1.0 | 1.9 | 3.0 | V |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ | | | | 4.6 | | mV/°C |
| Drain−to−Source On Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 2.2 A | | 190 | 215 | mΩ |
| | | $V_{GS}$ = 5.0 V | $I_D$ = 1.0 A | | 215 | 245 | |
| **CHARGES, CAPACITANCES AND GATE RESISTANCE** | | | | | | | |
| Input Capacitance | $C_{ISS}$ | $V_{GS}$ = 0 V, f = 1.0 MHz, $V_{DS}$ = 25 V | | | 220 | 400 | pF |
| Output Capacitance | $C_{OSS}$ | | | | 55 | 100 | |
| Reverse Transfer Capacitance | $C_{RSS}$ | | | | 16 | 30 | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = 5.0 V, $V_{DS}$ = 40 V, $I_D$ = 1.0 A | | | 5.0 | 9.0 | nC |
| Threshold Gate Charge | $Q_{G(TH)}$ | | | | 0.4 | | |
| Gate−to−Source Charge | $Q_{GS}$ | | | | 1.0 | | |
| Gate−to−Drain Charge | $Q_{GD}$ | | | | 2.75 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = 10 V, $V_{DS}$ = 40 V, $I_D$ = 1.0 A | | | 9.0 | 15 | nC |
| **SWITCHING CHARACTERISTICS** (Note 4) | | | | | | | |
| Turn−On Delay Time | $t_{d(ON)}$ | $V_{GS}$ = 4.5 V, $V_{DD}$ = 40 V, $I_D$ = 1.0 A, $R_G$ = 27 Ω | | | 21 | 35 | ns |
| Rise Time | $t_r$ | | | | 62 | 105 | |
| Turn−Off Delay Time | $t_{d(OFF)}$ | | | | 52 | 85 | |
| Fall Time | $t_f$ | | | | 50 | 85 | |
| Turn−On Delay Time | $t_{d(ON)}$ | $V_{GS}$ = 10 V, $V_{DD}$ = 40 V, $I_D$ = 2.5 A, $R_G$ = 47 Ω | | | 15 | | ns |
| Rise Time | $t_r$ | | | | 95 | | |
| Turn−Off Delay Time | $t_{d(OFF)}$ | | | | 50 | | |
| Fall Time | $t_f$ | | | | 105 | | |
| **BODY − DRAIN DIODE RATINGS** (Note 3) | | | | | | | |
| Forward Diode Voltage | $V_{SD}$ | $V_{GS}$ = 0 V, $I_D$ = 1.0 A | $T_J$ = 25°C | | 0.8 | 1.0 | V |
| | | | $T_J$ = 150°C | | 0.6 | | |
| Reverse Recovery Time | $t_{RR}$ | $V_{GS}$ = 0 V, $d_{IS}/d_t$ = 100 A/μs, $I_S$ = 1.0 A | | | 44 | | ns |
| Charge Time | $T_a$ | | | | 21 | | |
| Discharge Time | $T_b$ | | | | 23 | | |
| Reverse Recovery Time | $Q_{RR}$ | | | | 43 | 86 | nC |

3. Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%.
4. Switching characteristics are independent of operating junction temperatures.

## TYPICAL ELECTRICAL CHARACTERISTICS

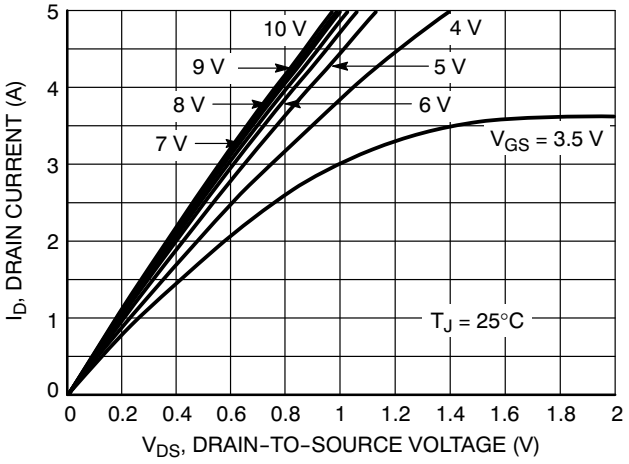



**Figure 1. On−Region Characteristics**

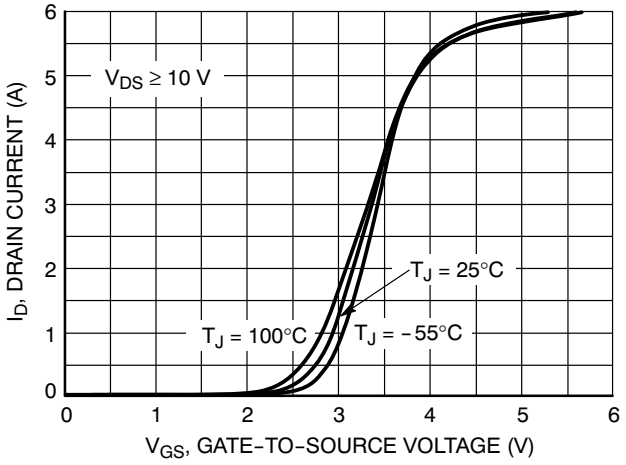



**Figure 2. Transfer Characteristics**

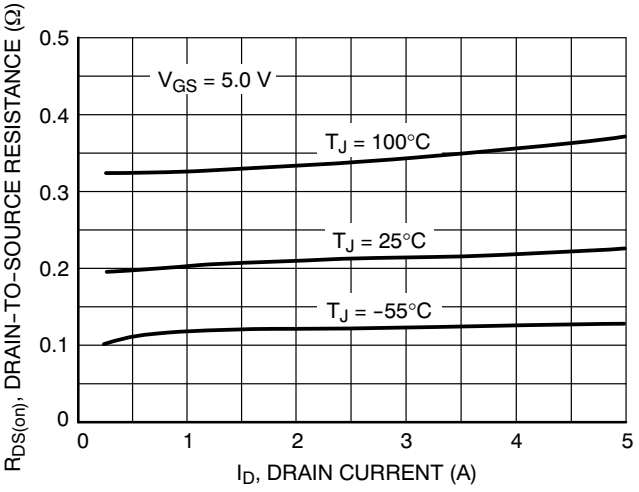



**Figure 3. On−Resistance versus Drain Current and Temperature**

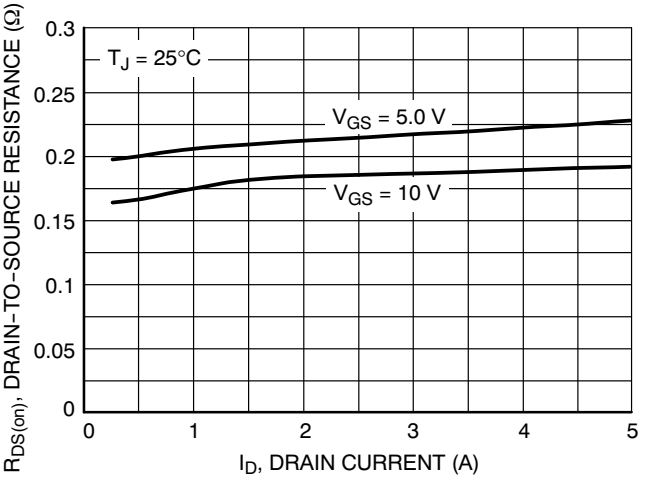



**Figure 4. On−Resistance versus Drain Current and Gate Voltage**

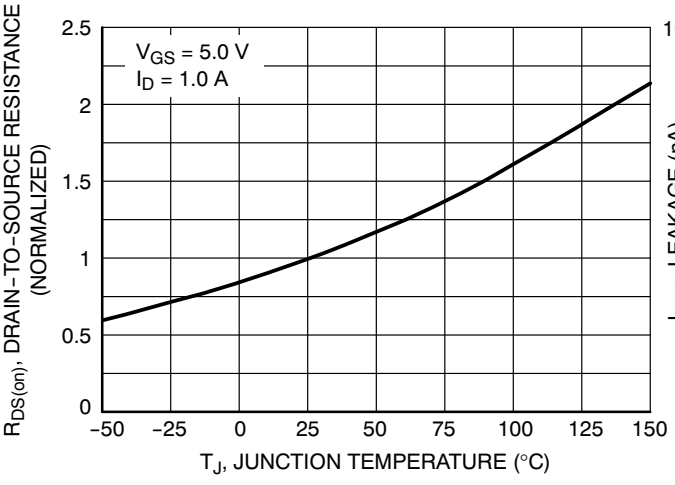



**Figure 5. On−Resistance Variation with Temperature**

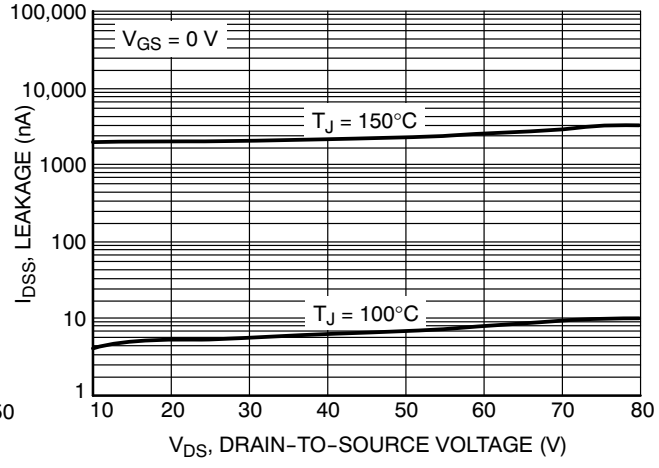



**Figure 6. Drain−To−Source Leakage Current versus Voltage**

## TYPICAL ELECTRICAL CHARACTERISTICS

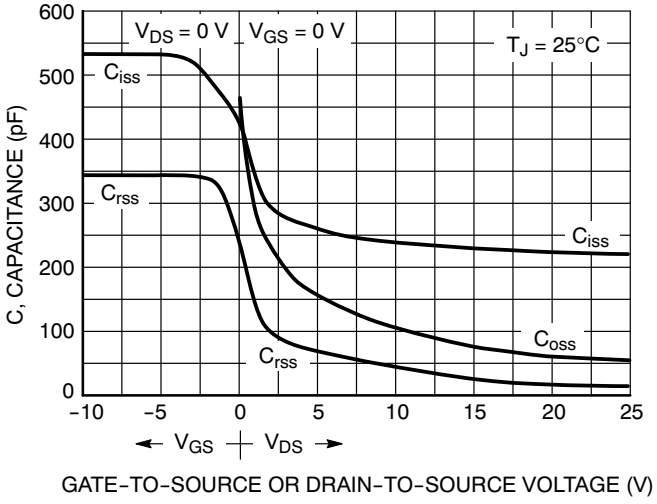



**Figure 7. Capacitance Variation**

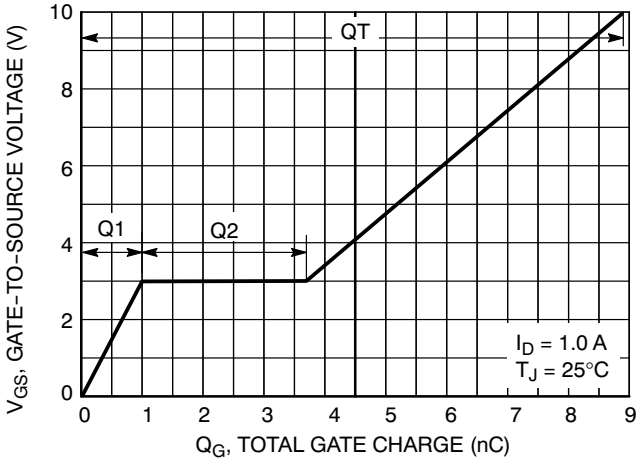



**Figure 8. Gate−To−Source and Drain−To−Source Voltage versus Total Charge**

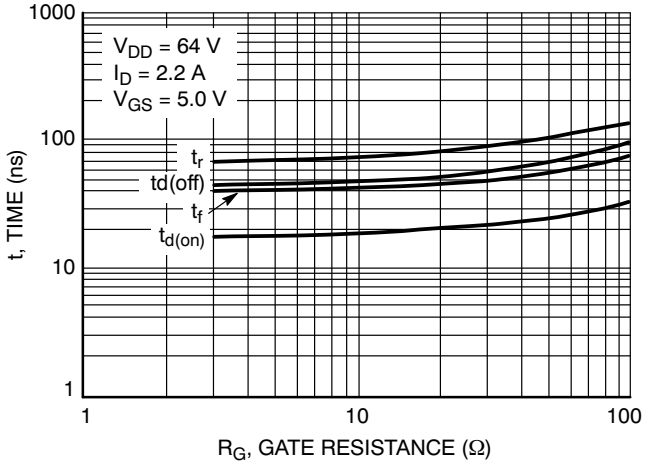



**Figure 9. Resistive Switching Time Variation versus Gate Resistance**

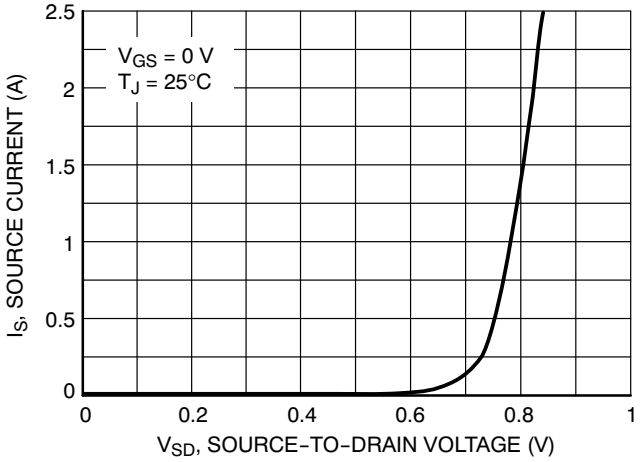



**Figure 10. Diode Forward Voltage versus Current**

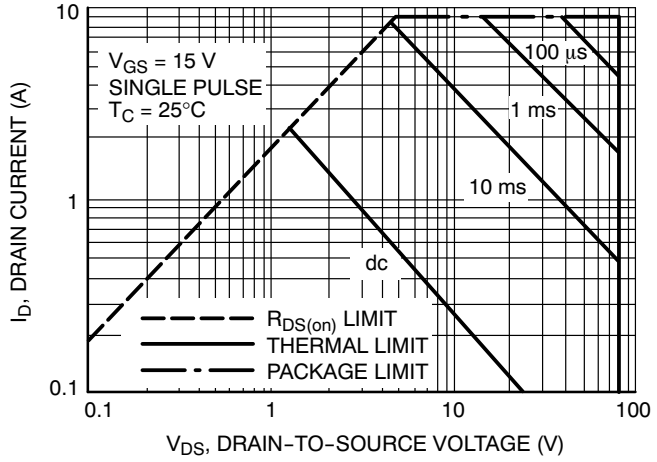



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

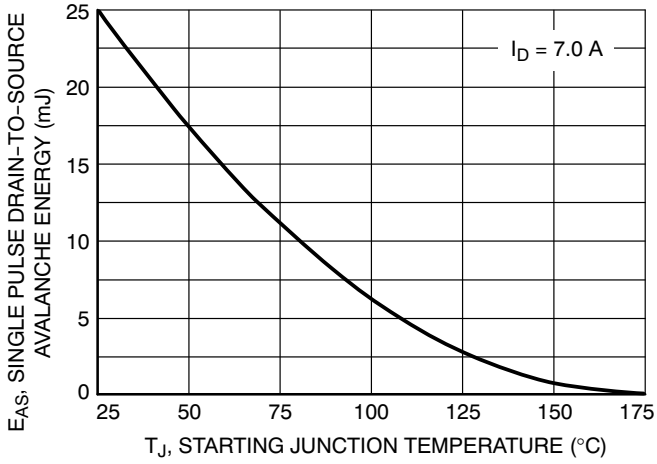



**Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature**

## TYPICAL ELECTRICAL CHARACTERISTICS

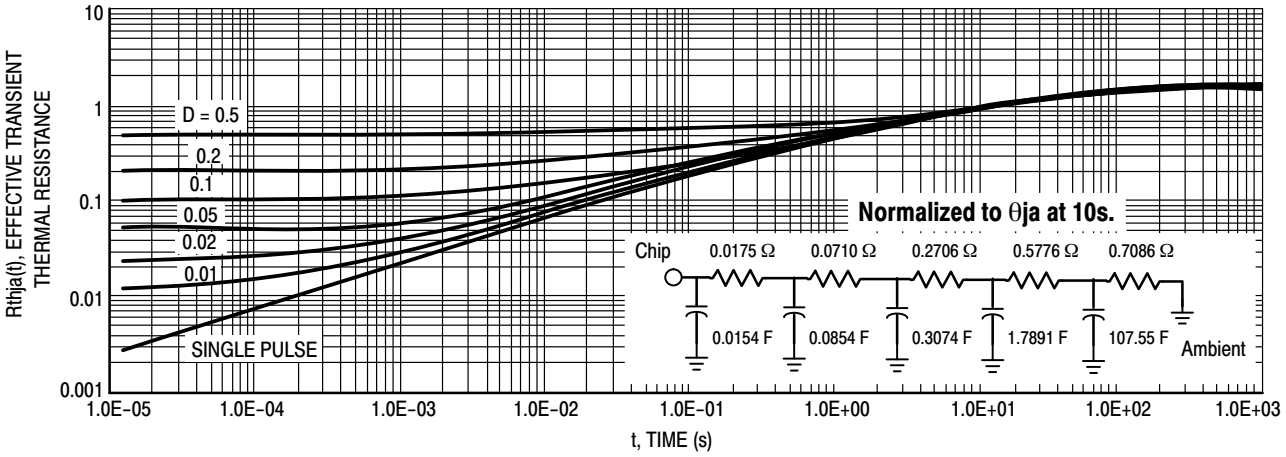



**Figure 13. Thermal Response**

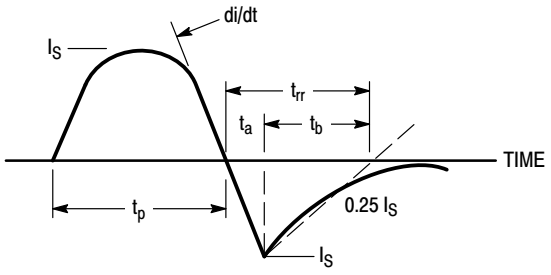
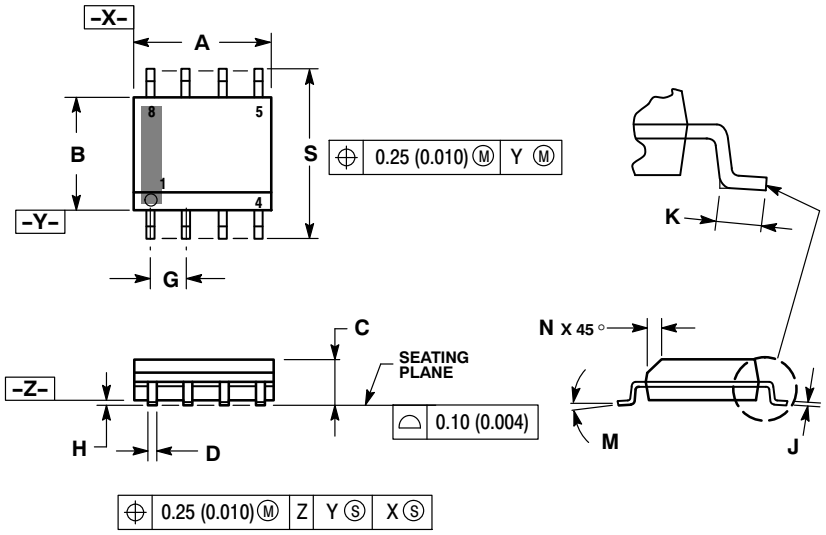



**Figure 14. Diode Reverse Recovery Waveform**

# NTMD6601NR2G

## PACKAGE DIMENSIONS

**SO−8 NB**
CASE 751−07
ISSUE AJ

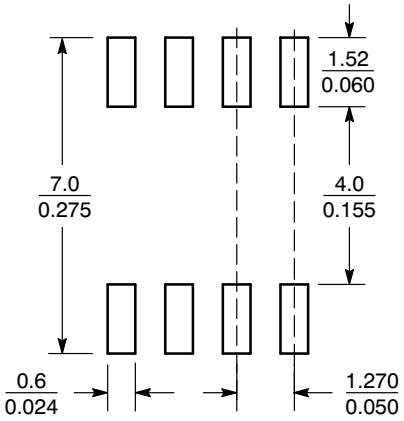



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005)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

| | 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 11:
PIN 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*




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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