# NTD5867NL

# N-Channel Power MOSFET 60 V, 20 A, 39 mΩ

**Features**

- Low $R_{DS(on)}$
- High Current Capability
- 100% Avalanche Tested
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

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

| Parameter | | | Symbol | Value | Unit |
|---|---|---|---|---|---|
| Drain−to−Source Voltage | | | $V_{DSS}$ | 60 | V |
| Gate−to−Source Voltage − Continuous | | | $V_{GS}$ | ±20 | V |
| Gate−to−Source Voltage − Non−Repetitive ($t_p$ < 10 μs) | | | $V_{GS}$ | ±30 | V |
| Continuous Drain Current ($R_{\theta JC}$) | Steady State | $T_C$ = 25°C | $I_D$ | 20 | A |
| | | $T_C$ = 100°C | | 13 | |
| Power Dissipation ($R_{\theta JC}$) | | $T_C$ = 25°C | $P_D$ | 36 | W |
| Pulsed Drain Current | $t_p$ = 10 μs | | $I_{DM}$ | 76 | A |
| Operating Junction and Storage Temperature | | | $T_J$, $T_{stg}$ | −55 to 150 | °C |
| Source Current (Body Diode) | | | $I_S$ | 20 | A |
| Single Pulse Drain−to−Source Avalanche Energy ($V_{DD}$ = 50 V, $V_{GS}$ = 10 V, $R_G$ = 25 Ω, $I_{L(pk)}$ = 19 A, L = 0.1 mH, $T_J$ = 25°C) | | | $E_{AS}$ | 18 | mJ |
| Lead Temperature for Soldering Purposes (1/8″ from case for 10 s) | | | $T_L$ | 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.

**THERMAL RESISTANCE MAXIMUM RATINGS**

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Junction−to−Case (Drain) | $R_{\theta JC}$ | 3.5 | °C/W |
| Junction−to−Ambient − Steady State (Note 1) | $R_{\theta JA}$ | 45 | |

1. Surface−mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces.

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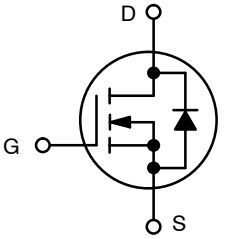
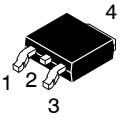
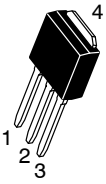
| $V_{(BR)DSS}$ | $R_{DS(on)}$ MAX | $I_D$ MAX |
|---|---|---|
| 60 V | 39 mΩ @ 10 V | 20 A |
| | 50 mΩ @ 4.5 V | 18 A |




**N−CHANNEL MOSFET**

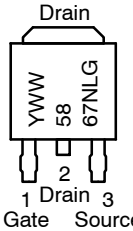


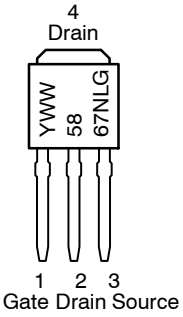

**DPAK**
**CASE 369AA**
**(Surface Mount)**
**STYLE 2**




**IPAK**
**CASE 369D**
**(Straight Lead)**
**STYLE 2**

**MARKING DIAGRAMS & PIN ASSIGNMENT**




Y = Year
WW = Work Week
5867NL = Device Code
G = Pb−Free Package

**ORDERING INFORMATION**

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

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

| Parameter | 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 | | 60 | | | V |
| Drain−to−Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | | | | 60 | | mV/°C |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 60 V | $T_J$ = 25°C | | | 1.0 | μA |
| | | | $T_J$ = 125°C | | | 100 | |
| Gate−to−Source Leakage Current | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ±20 V | | | | ±100 | nA |
| **ON CHARACTERISTICS** (Note 2) | | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | | 1.5 | 1.8 | 2.5 | V |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ | | | | 5.2 | | mV/°C |
| Drain−to−Source On Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 10 A | | | 26 | 39 | mΩ |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 10 A | | | 33 | 50 | |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$ = 15 V, $I_D$ = 10 A | | | 8.0 | | S |
| **CHARGES, CAPACITANCES AND GATE RESISTANCES** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, f = 1.0 MHz, $V_{DS}$ = 25 V | | | 675 | | pF |
| Output Capacitance | $C_{oss}$ | | | | 68 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | | 47 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = 10 V, $V_{DS}$ = 48 V, $I_D$ = 20 A | | | 15 | | nC |
| Threshold Gate Charge | $Q_{G(TH)}$ | | | | 1.0 | | |
| Gate−to−Source Charge | $Q_{GS}$ | | | | 2.2 | | |
| Gate−to−Drain Charge | $Q_{GD}$ | | | | 4.3 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = 4.5 V, $V_{DS}$ = 48 V, $I_D$ = 20 A | | | 7.6 | | nC |
| Gate Resistance | $R_G$ | | | | 1.3 | | Ω |
| **SWITCHING CHARACTERISTICS** (Note 3) | | | | | | | |
| Turn−On Delay Time | $t_{d(on)}$ | $V_{GS}$ = 10 V, $V_{DD}$ = 48 V, $I_D$ = 20 A, $R_G$ = 2.5 Ω | | | 6.5 | | ns |
| Rise Time | $t_r$ | | | | 12.6 | | |
| Turn−Off Delay Time | $t_{d(off)}$ | | | | 18.2 | | |
| Fall Time | $t_f$ | | | | 2.4 | | |
| **DRAIN−SOURCE DIODE CHARACTERISTICS** | | | | | | | |
| Forward Diode Voltage | $V_{SD}$ | $V_{GS}$ = 0 V, $I_S$ = 10 A | $T_J$ = 25°C | | 0.87 | 1.2 | V |
| | | | $T_J$ = 100°C | | 0.78 | | |
| Reverse Recovery Time | $t_{RR}$ | $V_{GS}$ = 0 V, dIs/dt = 100 A/μs, $I_S$ = 20 A | | | 17 | | ns |
| Charge Time | ta | | | | 13 | | |
| Discharge Time | tb | | | | 4.0 | | |
| Reverse Recovery Charge | $Q_{RR}$ | | | | 12 | | nC |

2. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
3. Switching characteristics are independent of operating junction temperatures.

## ORDERING INFORMATION

| Order Number | Package | Shipping† |
|---|---|---|
| NTD5867NL−1G | IPAK (Straight Lead) (Pb−Free) | 75 Units / Rail |
| NTD5867NLT4G | DPAK (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.

## TYPICAL PERFORMANCE CURVES

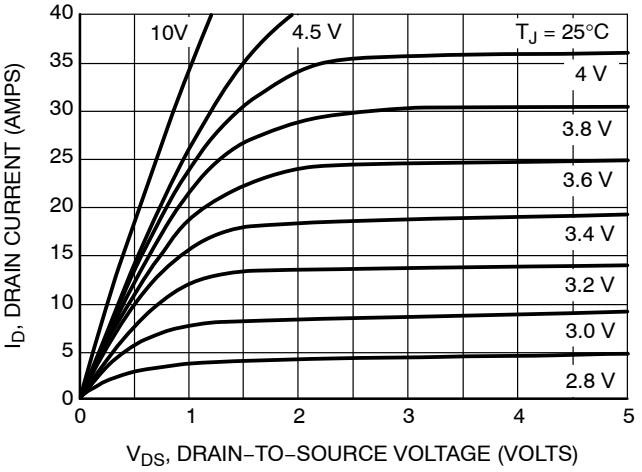



**Figure 1. On−Region Characteristics**

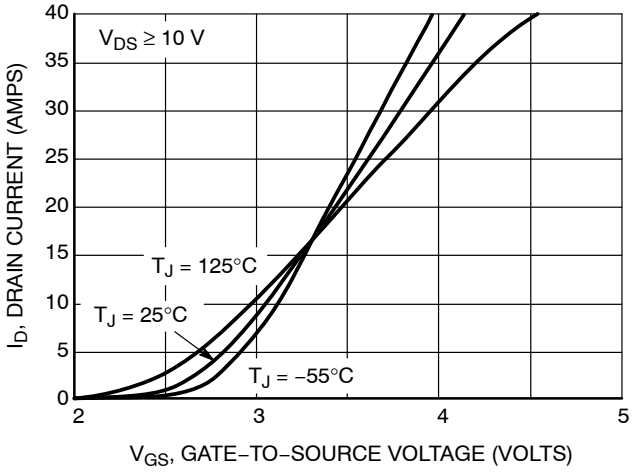



**Figure 2. Transfer Characteristics**

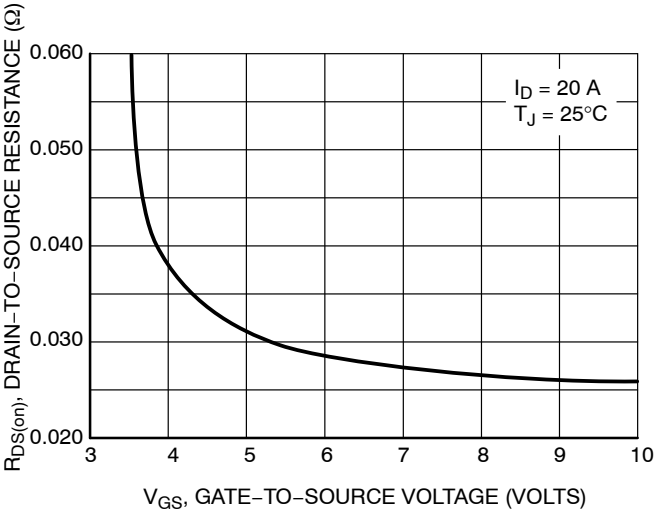



**Figure 3. On−Resistance vs. Gate−to−Source Voltage**

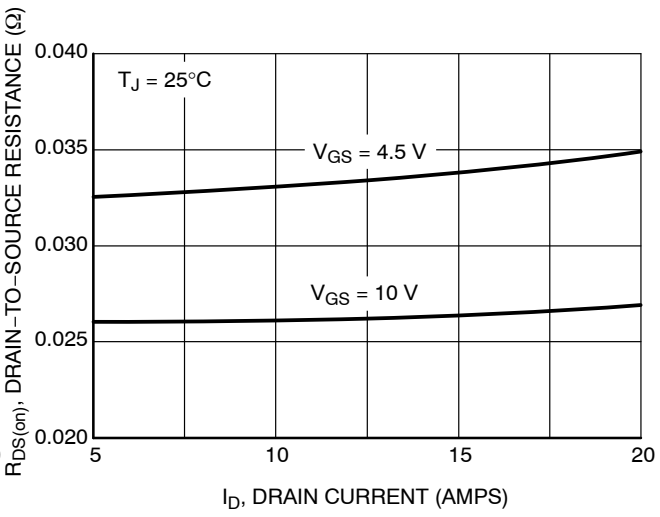



**Figure 4. On−Resistance vs. Drain Current and Gate Voltage**

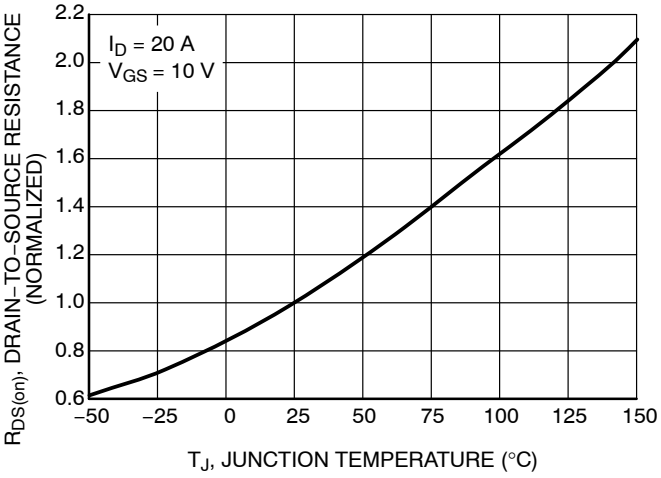



**Figure 5. On−Resistance Variation with Temperature**

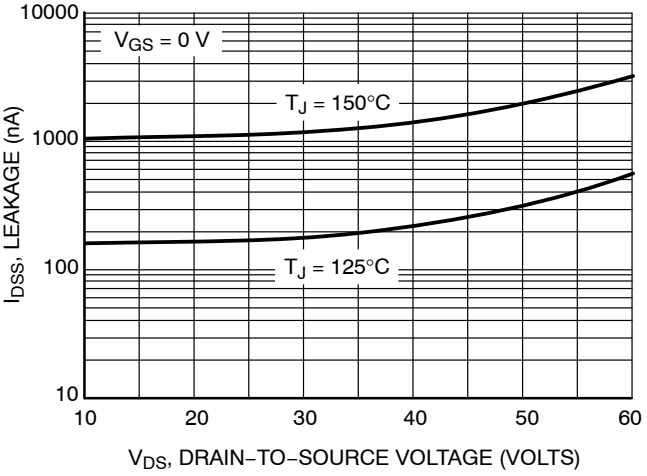



**Figure 6. Drain−to−Source Leakage Current vs. Drain Voltage**

## TYPICAL PERFORMANCE CURVES

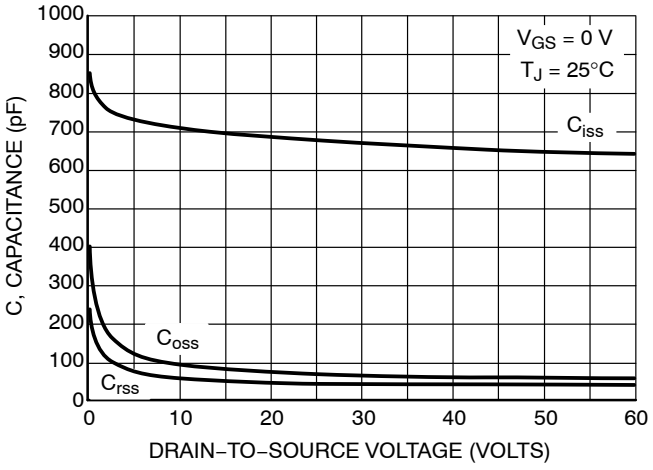



**Figure 7. Capacitance Variation**

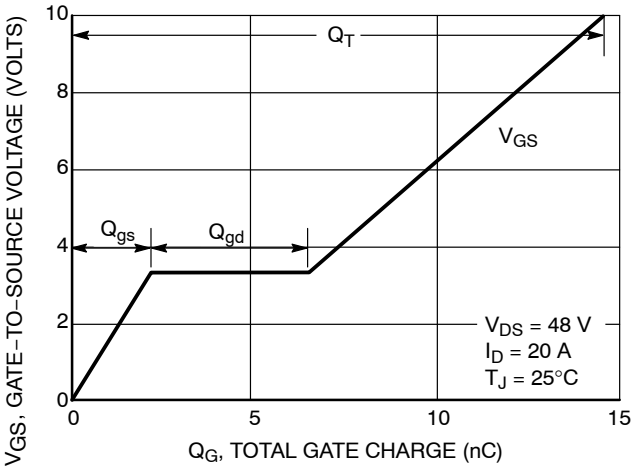



**Figure 8. Gate−To−Source Voltage vs. Total Charge**

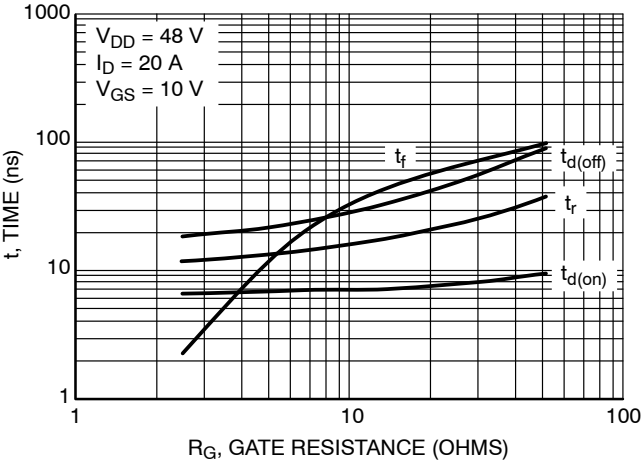



**Figure 9. Resistive Switching Time Variation vs. Gate Resistance**

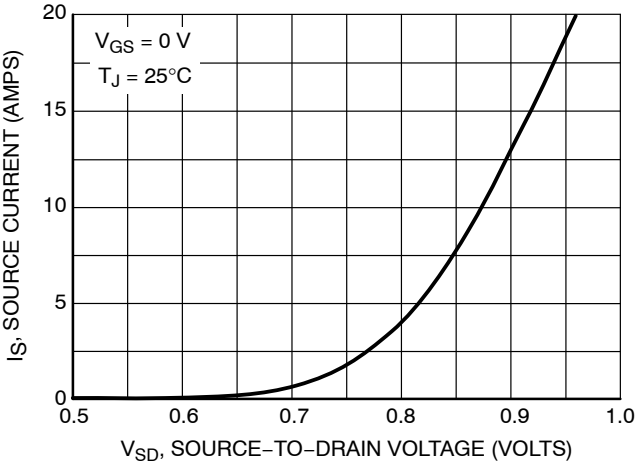



**Figure 10. Diode Forward Voltage vs. Current**

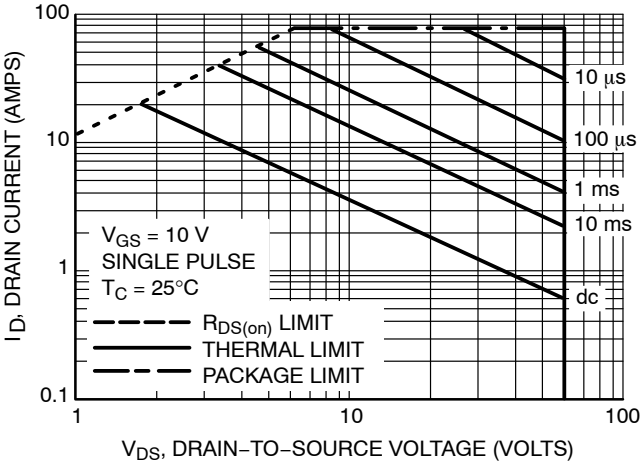



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

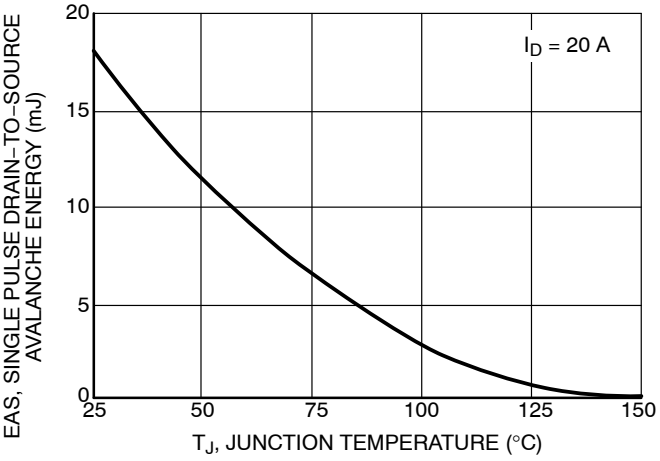



**Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature**

## TYPICAL PERFORMANCE CURVES

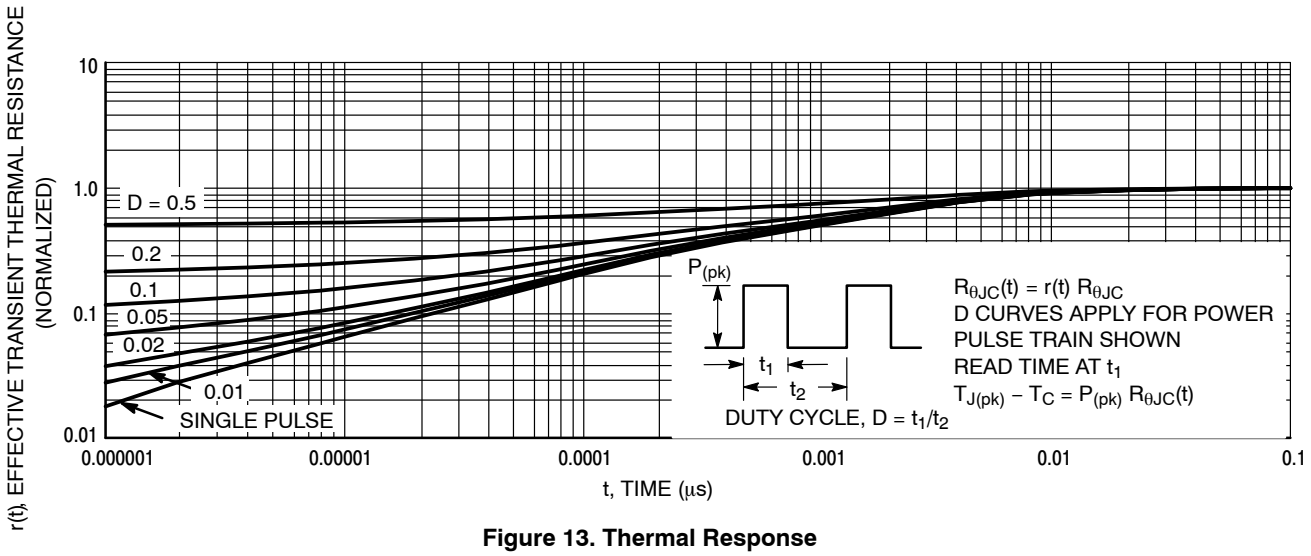
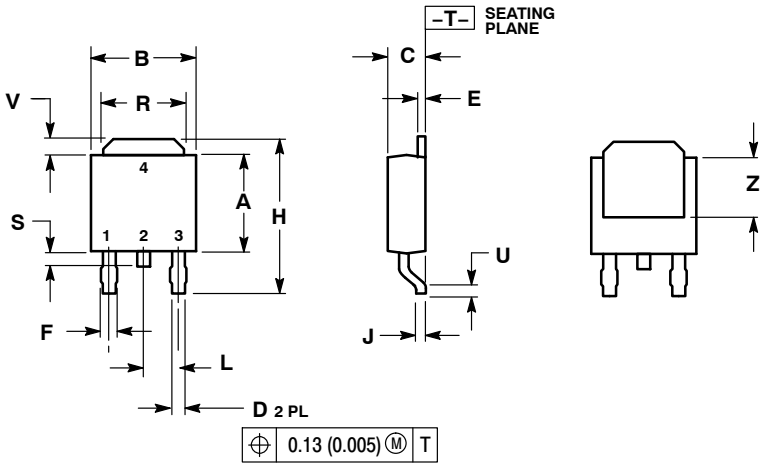



**Figure 13. Thermal Response**

## PACKAGE DIMENSIONS

**DPAK (SINGLE GUAGE)**
CASE 369AA−01
ISSUE A

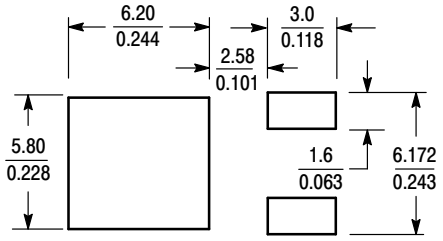



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.235 | 0.245 | 5.97 | 6.22 |
| B | 0.250 | 0.265 | 6.35 | 6.73 |
| C | 0.086 | 0.094 | 2.19 | 2.38 |
| D | 0.025 | 0.035 | 0.63 | 0.89 |
| E | 0.018 | 0.024 | 0.46 | 0.61 |
| F | 0.030 | 0.045 | 0.77 | 1.14 |
| H | 0.386 | 0.410 | 9.80 | 10.40 |
| J | 0.018 | 0.023 | 0.46 | 0.58 |
| L | 0.090 BSC | | 2.29 BSC | |
| R | 0.180 | 0.215 | 4.57 | 5.45 |
| S | 0.024 | 0.040 | 0.60 | 1.01 |
| U | 0.020 | −−− | 0.51 | −−− |
| V | 0.035 | 0.050 | 0.89 | 1.27 |
| Z | 0.155 | −−− | 3.93 | −−− |

STYLE 2:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

### SOLDERING FOOTPRINT*

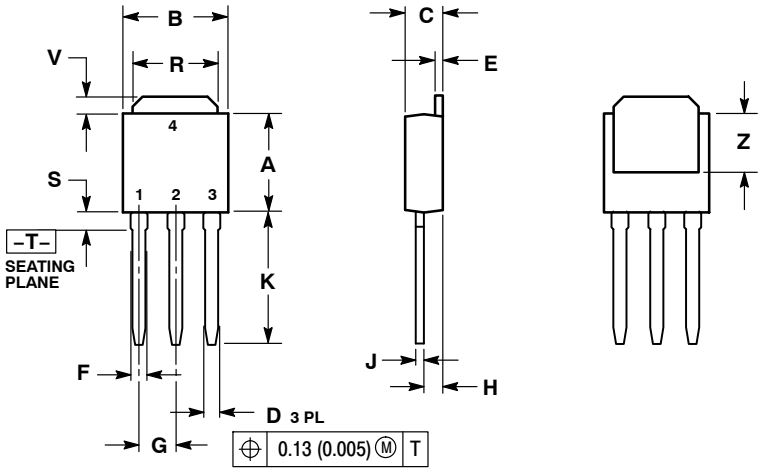



SCALE 3:1 $\left(\frac{mm}{inches}\right)$

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## PACKAGE DIMENSIONS

### IPAK (STRAIGHT LEAD DPAK)
CASE 369D−01
ISSUE B




NOTES:
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2. CONTROLLING DIMENSION: INCH.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.235 | 0.245 | 5.97 | 6.35 |
| B | 0.250 | 0.265 | 6.35 | 6.73 |
| C | 0.086 | 0.094 | 2.19 | 2.38 |
| D | 0.027 | 0.035 | 0.69 | 0.88 |
| E | 0.018 | 0.023 | 0.46 | 0.58 |
| F | 0.037 | 0.045 | 0.94 | 1.14 |
| G | 0.090 BSC | | 2.29 BSC | |
| H | 0.034 | 0.040 | 0.87 | 1.01 |
| J | 0.018 | 0.023 | 0.46 | 0.58 |
| K | 0.350 | 0.380 | 8.89 | 9.65 |
| R | 0.180 | 0.215 | 4.45 | 5.45 |
| S | 0.025 | 0.040 | 0.63 | 1.01 |
| V | 0.035 | 0.050 | 0.89 | 1.27 |
| Z | 0.155 | −−− | 3.93 | −−− |

STYLE 2:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN



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**NTD5867NL/D**