# NTD6415ANL, NVD6415ANL

# N-Channel Power MOSFET 100 V, 23 A, 56 mΩ, Logic Level

**Features**

- Low $R_{DS(on)}$
- 100% Avalanche Tested
- AEC−Q101 Qualified
- AEC Q101 Qualified − NVD6415ANL
- These Devices are Pb−Free and are RoHS Compliant

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

| Parameter | | | Symbol | Value | Unit |
|---|---|---|---|---|---|
| Drain−to−Source Voltage | | | $V_{DSS}$ | 100 | V |
| Gate−to−Source Voltage − Continuous | | | $V_{GS}$ | ±20 | V |
| Continuous Drain Current | Steady State | $T_C$ = 25°C | $I_D$ | 23 | A |
| | | $T_C$ = 100°C | | 16 | |
| Power Dissipation | Steady State | $T_C$ = 25°C | $P_D$ | 83 | W |
| Pulsed Drain Current | $t_p$ = 10 μs | | $I_{DM}$ | 80 | A |
| Operating and Storage Temperature Range | | | $T_J$, $T_{stg}$ | −55 to +175 | °C |
| Source Current (Body Diode) | | | $I_S$ | 23 | A |
| Single Pulse Drain−to−Source Avalanche Energy ($V_{DD}$ = 50 Vdc, $V_{GS}$ = 10 Vdc, $I_{L(pk)}$ = 23 A, L = 0.3 mH, $R_G$ = 25 Ω) | | | $E_{AS}$ | 79 | mJ |
| Lead Temperature for Soldering Purposes, 1/8″ from Case for 10 Seconds | | | $T_L$ | 260 | °C |

**THERMAL RESISTANCE RATINGS**

| Parameter | Symbol | Max | Unit |
|---|---|---|---|
| Junction−to−Case (Drain) − Steady State | $R_{\theta JC}$ | 1.8 | °C/W |
| Junction−to−Ambient − Steady State (Note 1) | $R_{\theta JA}$ | 39 | |

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. Surface mounted on FR4 board using 1 sq in pad size, (Cu Area 1.127 sq in [2 oz] including traces).

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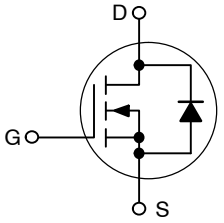
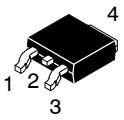
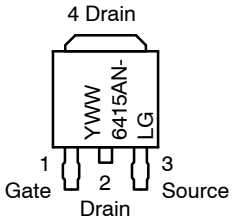
| $V_{(BR)DSS}$ | $R_{DS(on)}$ MAX | $I_D$ MAX |
|---|---|---|
| 100 V | 56 mΩ @ 4.5 V | 23 A |
| | 52 mΩ @ 10 V | |




**DPAK**
**CASE 369AA**
**STYLE 2**

**MARKING DIAGRAM & PIN ASSIGNMENT**




6415ANL = Device Code
Y = Year
WW = Work Week
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<br>$V_{GS}$ = 0 V, $I_D$ = 250 μA, $T_J$ = −40°C | | 100<br>92 | | | V |
| Drain−to−Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | | | | 115 | | mV/°C |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 100 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 | | 1.0 | | 2.0 | V |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ | | | | 4.8 | | mV/°C |
| Drain−to−Source On−Resistance | $R_{DS(on)}$ | $V_{GS}$ = 4.5 V, $I_D$ = 10 A | | | 44 | 56 | mΩ |
| | | $V_{GS}$ = 10 V, $I_D$ = 10 A | | | 43 | 52 | |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$ = 5.0 V, $I_D$ = 10 A | | | 24 | | S |
| **CHARGES, CAPACITANCES AND GATE RESISTANCE** | | | | | | | |
| Input Capacitance | $C_{ISS}$ | $V_{GS}$ = 0 V, f = 1.0 MHz, $V_{DS}$ = 25 V | | | 1024 | | pF |
| Output Capacitance | $C_{OSS}$ | | | | 156 | | |
| Reverse Transfer Capacitance | $C_{RSS}$ | | | | 70 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = 4.5 V, $V_{DS}$ = 80 V, $I_D$ = 23 A | | | 20 | | nC |
| Threshold Gate Charge | $Q_{G(TH)}$ | | | | 1.1 | | |
| Gate−to−Source Charge | $Q_{GS}$ | | | | 3.1 | | |
| Gate−to−Drain Charge | $Q_{GD}$ | | | | 14 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = 10 V, $V_{DS}$ = 80 V, $I_D$ = 23 A | | | 35 | | nC |
| **SWITCHING CHARACTERISTICS** (Note 3) | | | | | | | |
| Turn−On Delay Time | $t_{d(on)}$ | $V_{GS}$ = 4.5 V, $V_{DD}$ = 80 V, $I_D$ = 23 A, $R_G$ = 6.1 Ω | | | 11 | | ns |
| Rise Time | $t_r$ | | | | 91 | | |
| Turn−Off Delay Time | $t_{d(off)}$ | | | | 40 | | |
| Fall Time | $t_f$ | | | | 71 | | |
| **DRAIN−SOURCE DIODE CHARACTERISTICS** | | | | | | | |
| Forward Diode Voltage | $V_{SD}$ | $V_{GS}$ = 0 V, $I_S$ = 23 A | $T_J$ = 25°C | | 0.87 | 1.2 | V |
| | | | $T_J$ = 125°C | | 0.74 | | |
| Reverse Recovery Time | $t_{RR}$ | $V_{GS}$ = 0 V, $dI_S/dt$ = 100 A/μs, $I_S$ = 23 A | | | 64 | | ns |
| Charge Time | $T_a$ | | | | 40 | | |
| Discharge Time | $T_b$ | | | | 24 | | |
| Reverse Recovery Charge | $Q_{RR}$ | | | | 152 | | nC |

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

## ORDERING INFORMATION

| Device | Package | Shipping† |
|---|---|---|
| NTD6415ANLT4G | DPAK<br>(Pb−Free) | 2500 / Tape & Reel |
| NVD6415ANLT4G | DPAK<br>(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.

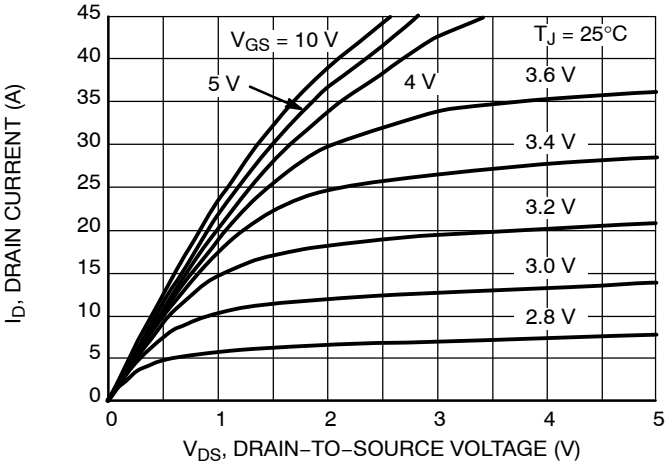



**Figure 1. On−Region Characteristics**

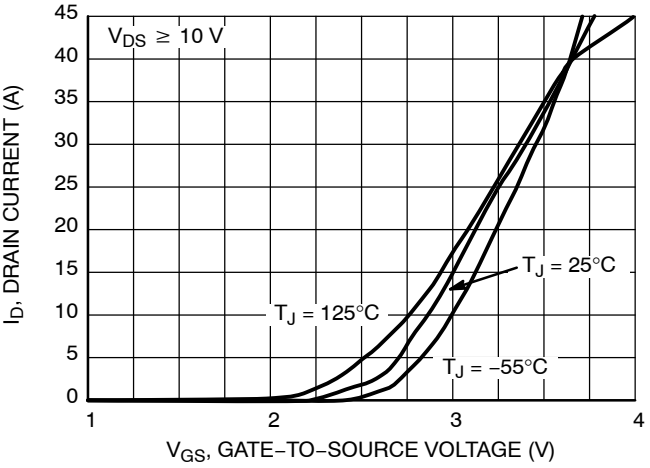



**Figure 2. Transfer Characteristics**

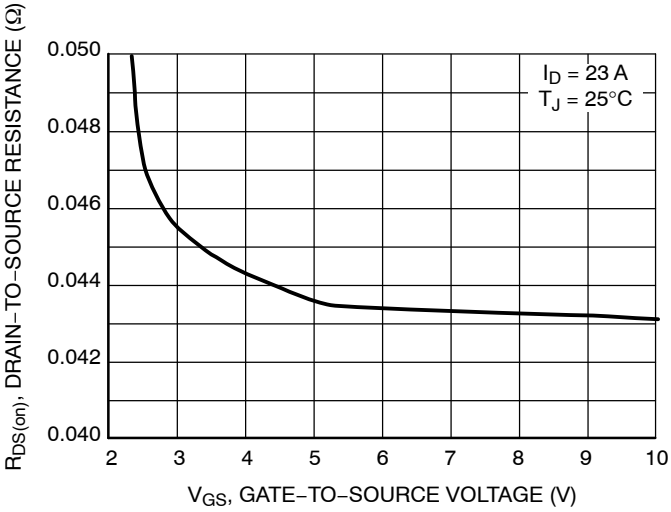



**Figure 3. On−Region versus Gate Voltage**

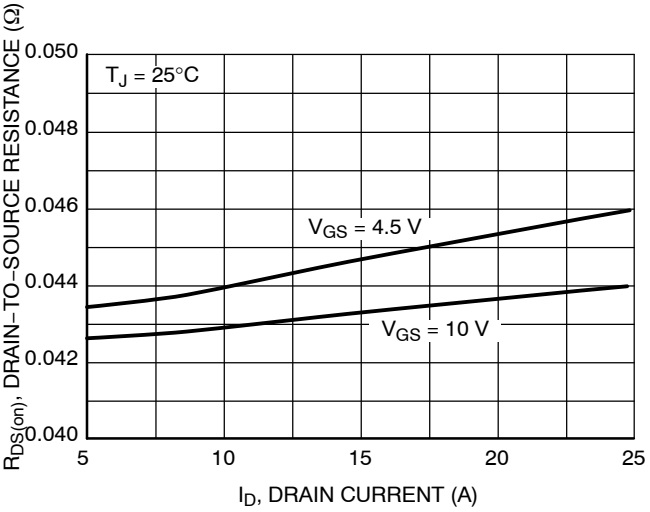



**Figure 4. On−Resistance versus Drain Current and Gate Voltage**

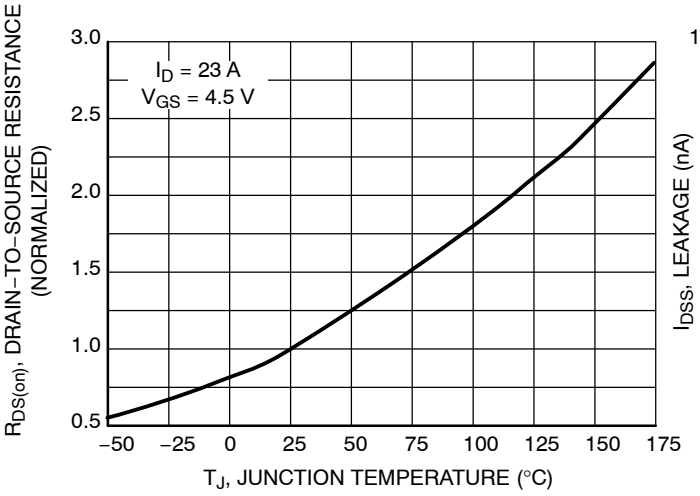



**Figure 5. On−Resistance Variation with Temperature**

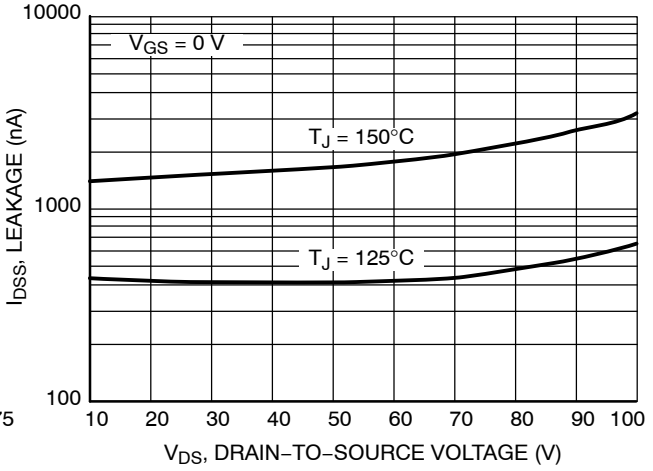



**Figure 6. Drain−to−Source Leakage Current versus Voltage**

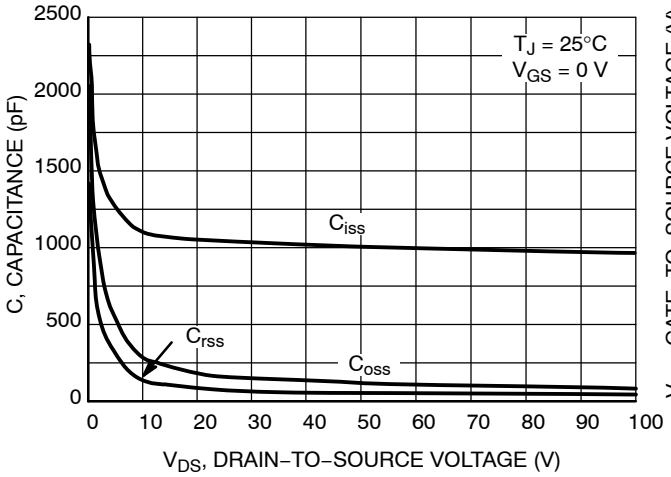



**Figure 7. Capacitance Variation**

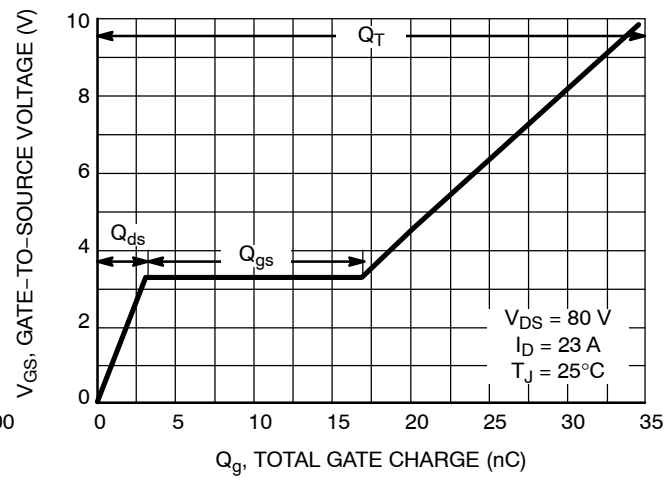



**Figure 8. Gate−to−Source Voltage and Drain−to−Source Voltage versus Total Charge**

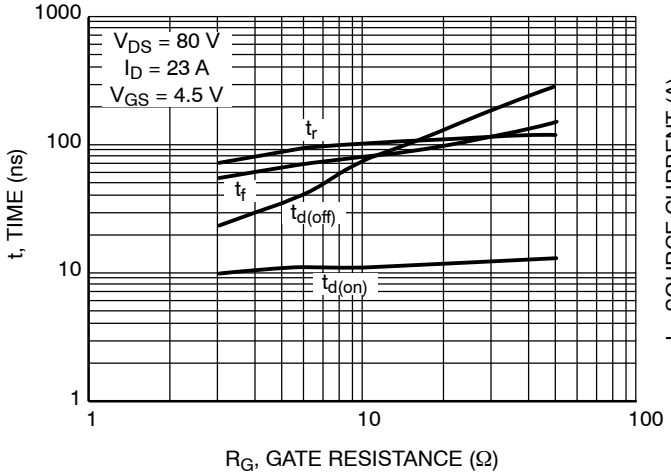



**Figure 9. Resistive Switching Time Variation versus Gate Resistance**

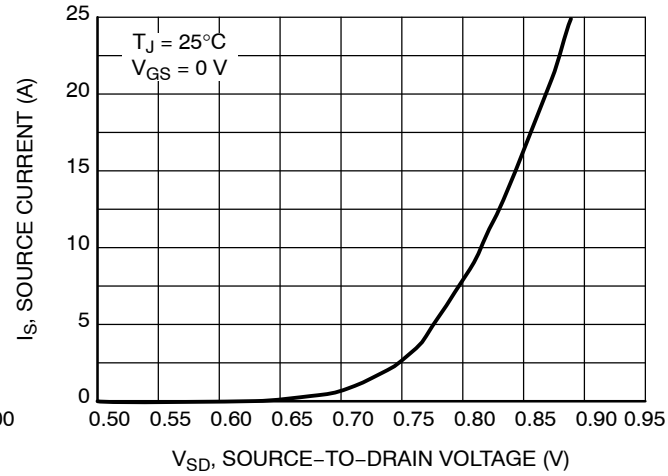



**Figure 10. Diode Forward Voltage versus Current**

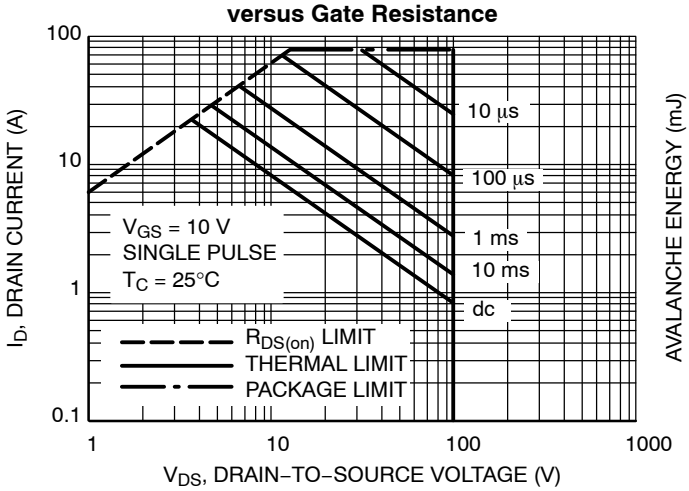



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

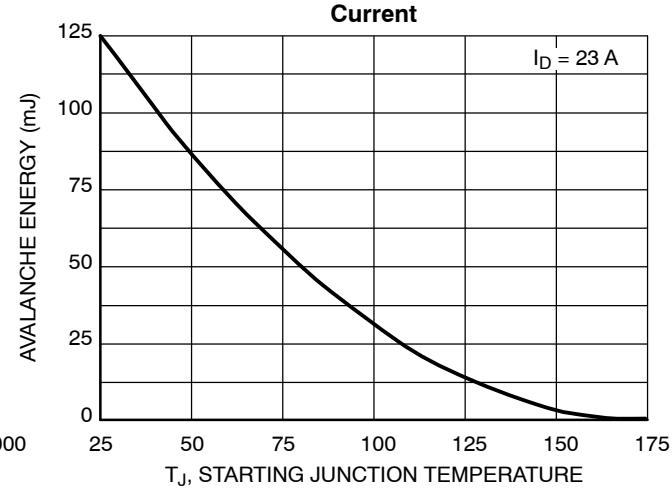



**Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature**

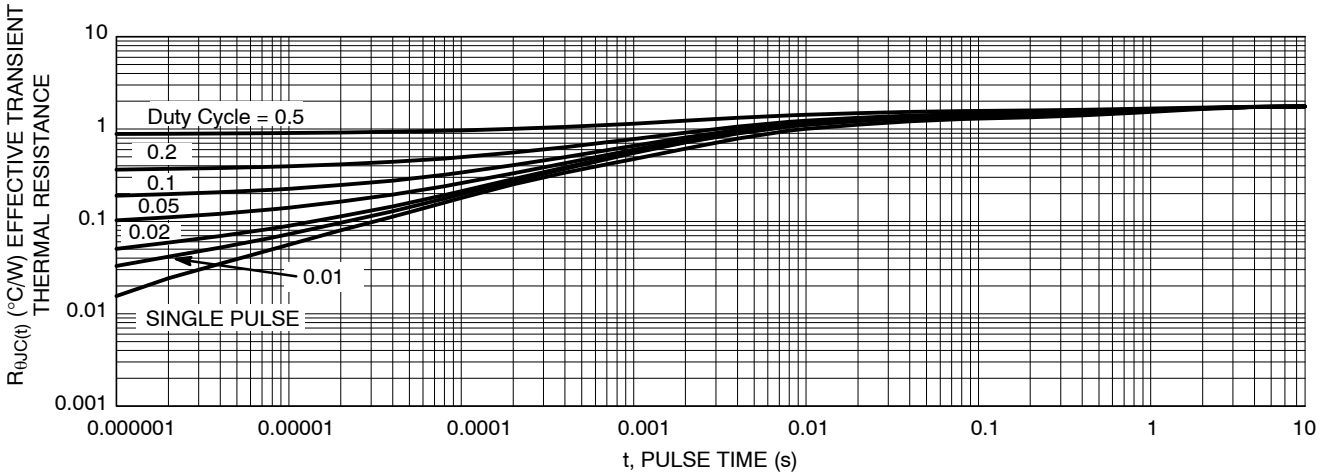
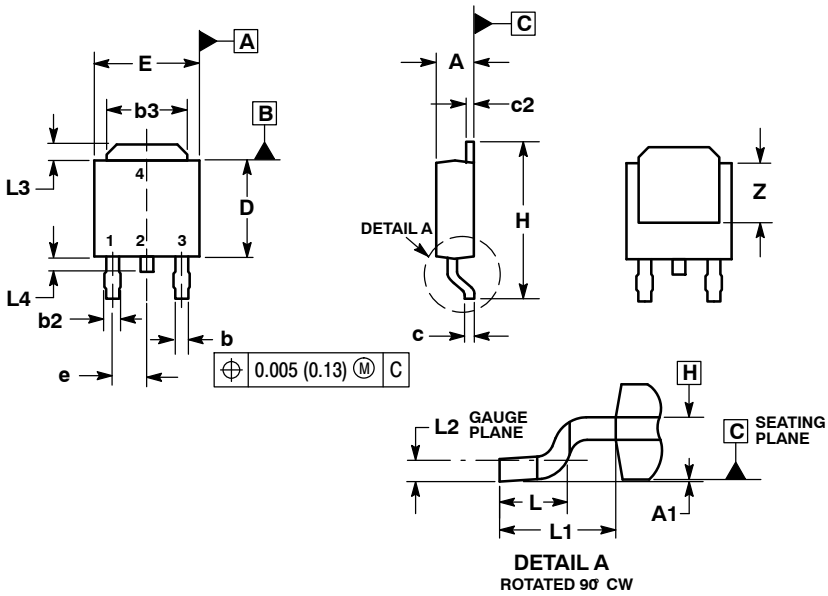



**Figure 13. Thermal Response**

## PACKAGE DIMENSIONS

### DPAK (SINGLE GUAGE)
CASE 369AA−01
ISSUE B

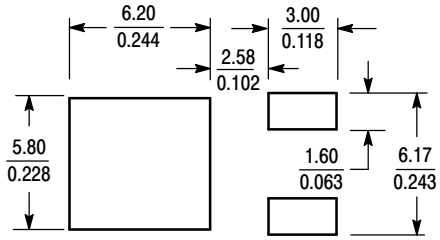



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES PER SIDE.
5. DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
6. DATUMS A AND B ARE DETERMINED AT DATUM PLANE H.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.086 | 0.094 | 2.18 | 2.38 |
| A1 | 0.000 | 0.005 | 0.00 | 0.13 |
| b | 0.025 | 0.035 | 0.63 | 0.89 |
| b2 | 0.030 | 0.045 | 0.76 | 1.14 |
| b3 | 0.180 | 0.215 | 4.57 | 5.46 |
| c | 0.018 | 0.024 | 0.46 | 0.61 |
| c2 | 0.018 | 0.024 | 0.46 | 0.61 |
| D | 0.235 | 0.245 | 5.97 | 6.22 |
| E | 0.250 | 0.265 | 6.35 | 6.73 |
| e | 0.090 BSC | | 2.29 BSC | |
| H | 0.370 | 0.410 | 9.40 | 10.41 |
| L | 0.055 | 0.070 | 1.40 | 1.78 |
| L1 | 0.108 REF | | 2.74 REF | |
| L2 | 0.020 BSC | | 0.51 BSC | |
| L3 | 0.035 | 0.050 | 0.89 | 1.27 |
| L4 | −−− | 0.040 | −−− | 1.01 |
| Z | 0.155 | −−− | 3.93 | −−− |

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

### SOLDERING FOOTPRINT*




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

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



**PUBLICATION ORDERING INFORMATION**

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