# NTD5414N

# Power MOSFET

## 24 Amps, 60 Volts Single N−Channel DPAK

### Features

- Low $R_{DS(on)}$
- High Current Capability
- Avalanche Energy Specified
- These are Pb−Free Devices

### Applications

- LED Lighting and LED Backlight Drivers
- DC−DC Converters
- DC Motor Drivers
- Power Supplies Secondary Side Synchronous Rectification

**MAXIMUM RATINGS** ($T_J$ = 25°C Unless otherwise specified)

| 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 − Nonrepetitive ($T_P$ < 10 μs) | | | $V_{GS}$ | ±30 | V |
| Continuous Drain Current $R_{\theta JC}$ (Note 1) | Steady State | $T_C$ = 25°C | $I_D$ | 24 | A |
| | | $T_C$ = 100°C | | 16 | |
| Power Dissipation $R_{\theta JC}$ (Note 1) | Steady State | $T_C$ = 25°C | $P_D$ | 55 | W |
| Pulsed Drain Current | $t_p$ = 10 μs | | $I_{DM}$ | 75 | A |
| Operating and Storage Temperature Range | | | $T_J$, $T_{stg}$ | −55 to +175 | °C |
| Source Current (Body Diode) | | | $I_S$ | 24 | A |
| Single Pulse Drain−to−Source Avalanche Energy − Starting $T_J$ = 25°C ($V_{DD}$ = 50 $V_{dc}$, $V_{GS}$ = 10 V, $I_{L(pk)}$ = 24 A, L = 0.3 mH, $R_G$ = 25 Ω) | | | $E_{AS}$ | 86.4 | 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 (Note 1) | $R_{\theta JC}$ | 2.7 | °C/W |
| | $R_{\theta JA}$ | 58.6 | |

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 [1 oz] including traces).

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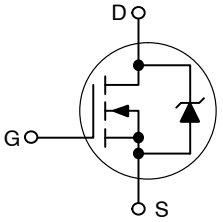
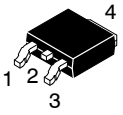
| $V_{(BR)DSS}$ | $R_{DS(ON)}$ MAX | $I_D$ MAX (Note 1) |
|---|---|---|
| 60 V | 37 mΩ @ 10 V | 24 A |

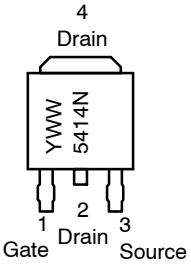
**N−Channel**




**MARKING DIAGRAMS**




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




5414N = Device Code
Y = Year
WW = Work Week
G = Pb−Free Device

**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 specified)

| Characteristics | Symbol | Test Condition | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | | |
| Drain−to−Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{DS}$ = 0 V, $I_D$ = 250 μA | | 60 | | | V |
| Drain−to−Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | | | | 67.3 | | mV/°C |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 60 V | $T_J$ = 25°C | | | 1.0 | μA |
| | | | $T_J$ = 150°C | | | 50 | |
| Gate−Body 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 | | 2.0 | 3.2 | 4.0 | V |
| Negative Threshold Temperature Coefficient | $V_{GS(th)}/T_J$ | | | | 0.74 | | mV/°C |
| Drain−to−Source On−Voltage | $V_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 24 A | | | 0.7 | 1.16 | V |
| | | $V_{GS}$ = 10 V, $I_D$ = 12 A, 150°C | | | 0.7 | | |
| Drain−to−Source On−Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 24 A | | | 28.4 | 37 | mΩ |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$ = 15 V, $I_D$ = 20 A | | | 24 | | S |
| **CHARGES, CAPACITANCES & GATE RESISTANCE** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1 MHz | | | 800 | 1200 | pF |
| Output Capacitance | $C_{oss}$ | | | | 165 | | |
| Transfer Capacitance | $C_{rss}$ | | | | 75 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = 10 V, $V_{DS}$ = 48 V, $I_D$ = 24 A | | | 25 | 48 | nC |
| Threshold Gate Charge | $Q_{G(TH)}$ | | | | 1.1 | | |
| Gate−to−Source Charge | $Q_{GS}$ | | | | 4.8 | | |
| Gate−to−Drain Charge | $Q_{GD}$ | | | | 11.3 | | |
| **SWITCHING CHARACTERISTICS, $V_{GS}$ = 10 V** (Note 3) | | | | | | | |
| Turn−On Delay Time | $t_{d(on)}$ | $V_{GS}$ = 10 V, $V_{DD}$ = 48 V, $I_D$ = 24 A, $R_G$ = 9.1 Ω | | | 12 | | ns |
| Rise Time | $t_r$ | | | | 58 | | |
| Turn−Off Delay Time | $t_{d(off)}$ | | | | 47 | | |
| Fall Time | $t_f$ | | | | 69 | | |
| **DRAIN−SOURCE DIODE CHARACTERISTICS** | | | | | | | |
| Forward Diode Voltage (Note 2) | $V_{SD}$ | $V_{GS}$ = 0 V, $I_S$ = 24 A | $T_J$ = 25°C | | 0.92 | 1.15 | V |
| | | | $T_J$ = 125°C | | 0.8 | | |
| Reverse Recovery Time | $t_{rr}$ | $I_S$ = 24 $A_{dc}$, $V_{GS}$ = 0 $V_{dc}$, $dI_S/dt$ = 100 A/μs | | | 45.7 | | ns |
| Charge Time | $t_a$ | | | | 31.7 | | |
| Discharge Time | $t_b$ | | | | 14 | | |
| Reverse Recovery Stored Charge | $Q_{RR}$ | | | | 76 | | 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† |
|---|---|---|
| NTD5414NT4G | 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

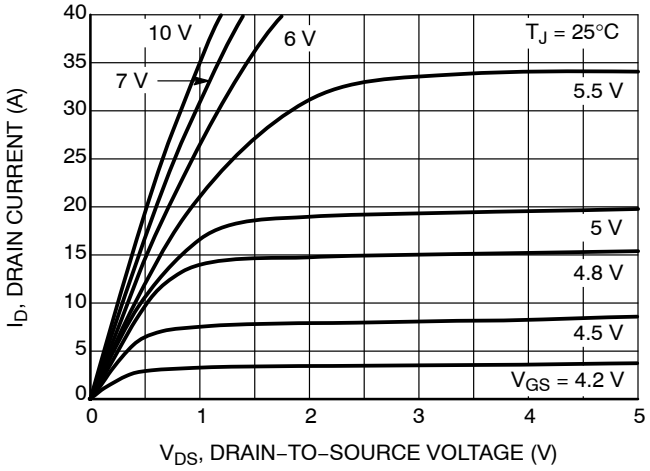



**Figure 1. On−Region Characteristics**

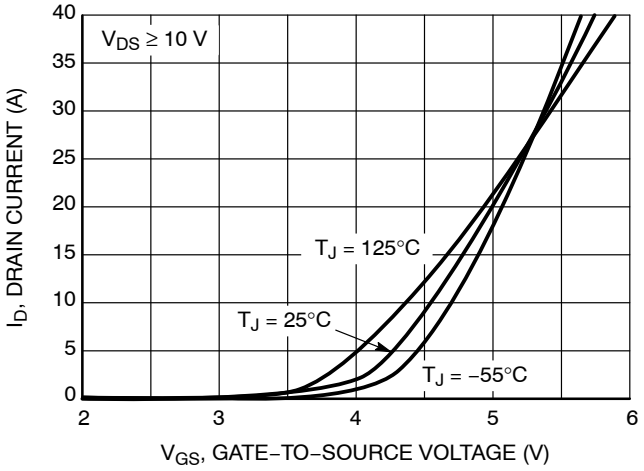



**Figure 2. Transfer Characteristics**

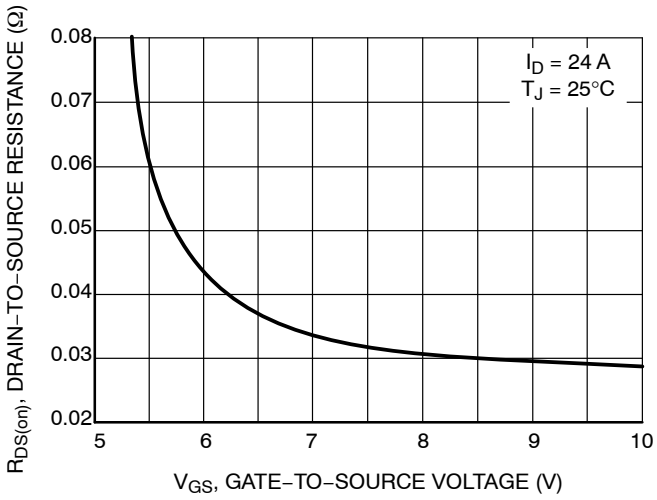



**Figure 3. On−Resistance vs. Gate−to−Source Voltage**

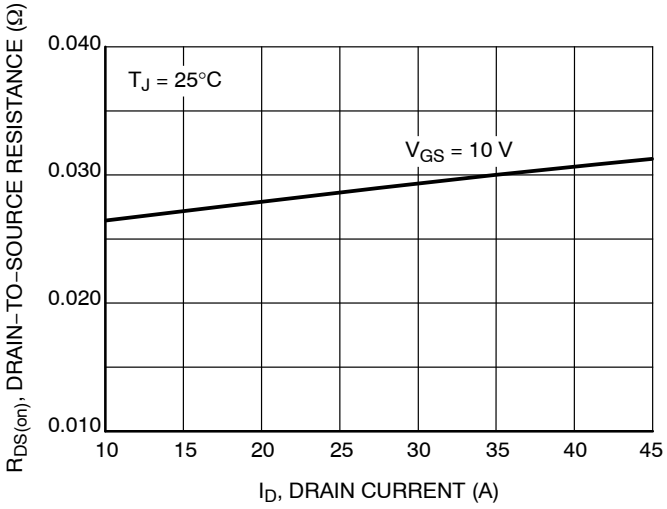



**Figure 4. On−Resistance vs. Drain Current and Gate Voltage**

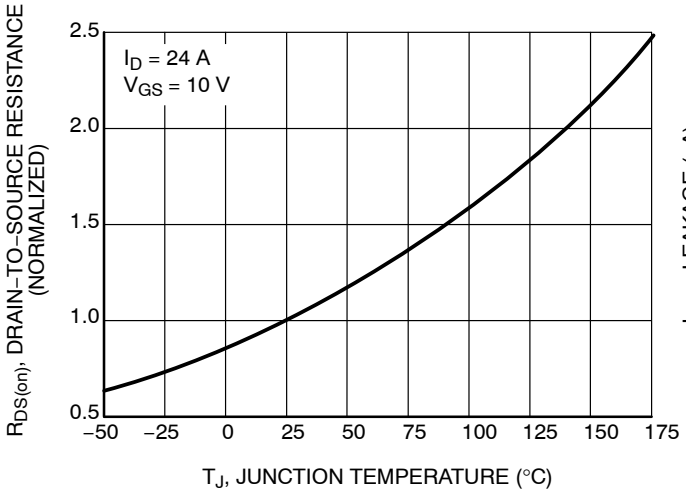



**Figure 5. On−Resistance Variation with Temperature**

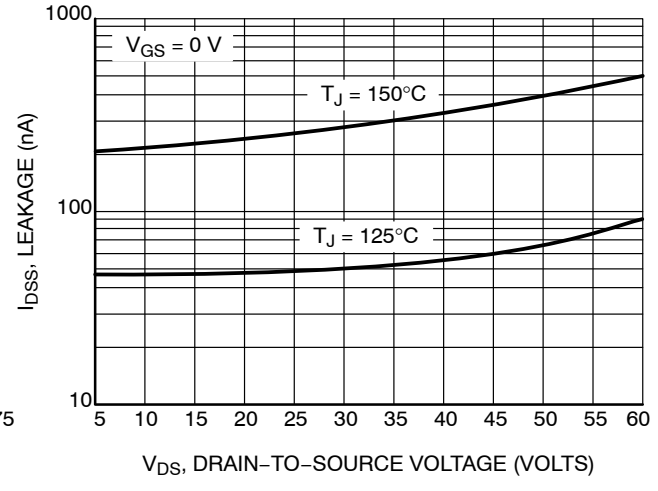



**Figure 6. Drain−to−Source Leakage Current vs. Voltage**

## TYPICAL PERFORMANCE CURVES

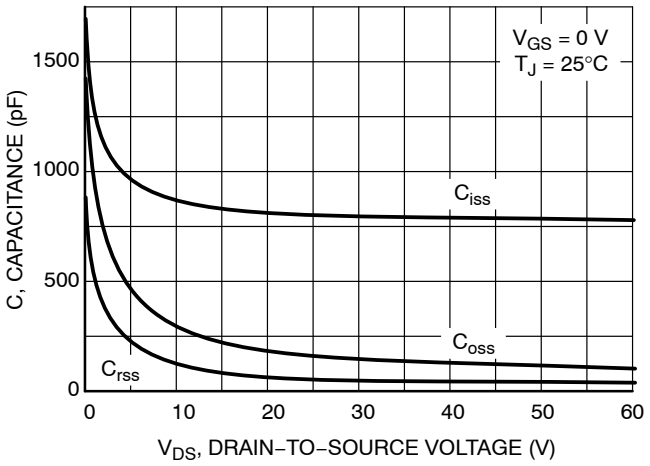



**Figure 7. Capacitance Variation**

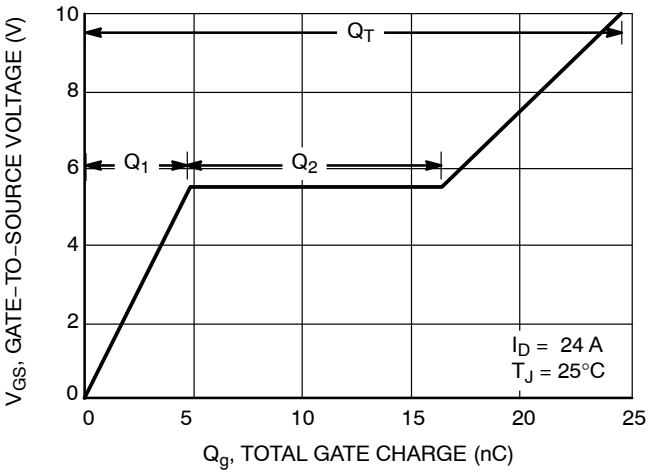



**Figure 8. Gate−to−Source Voltage vs. Total Charge**

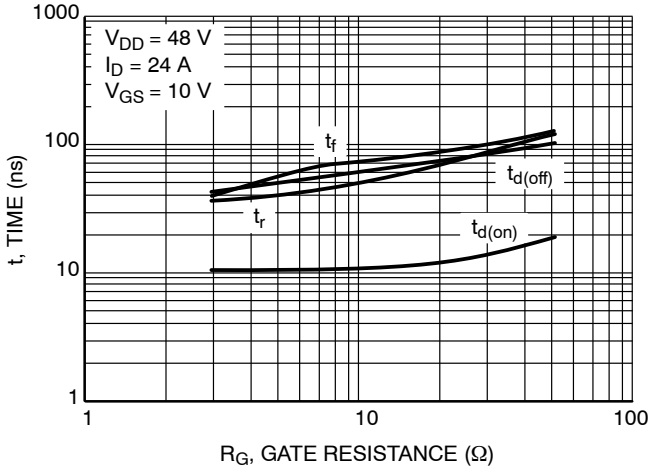



**Figure 9. Resistive Switching Time Variation vs. Gate Resistance**

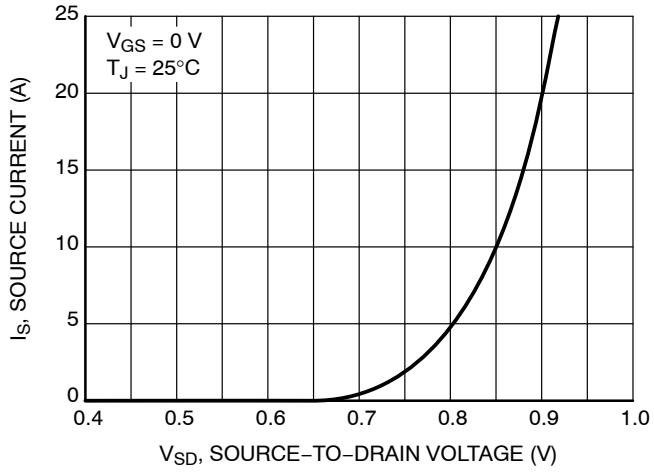



**Figure 10. Diode Forward Voltage vs. Current**

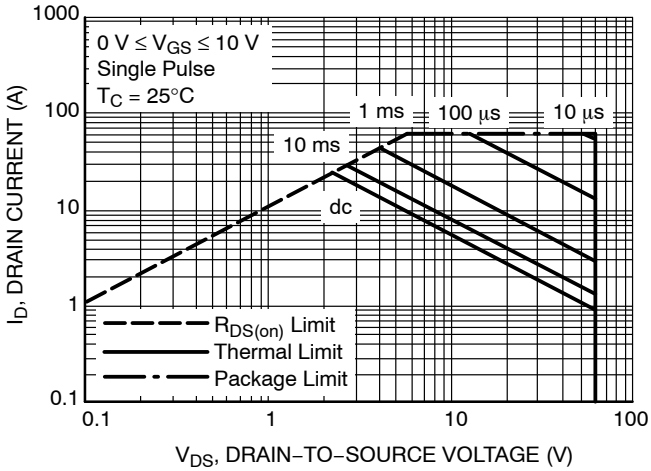



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

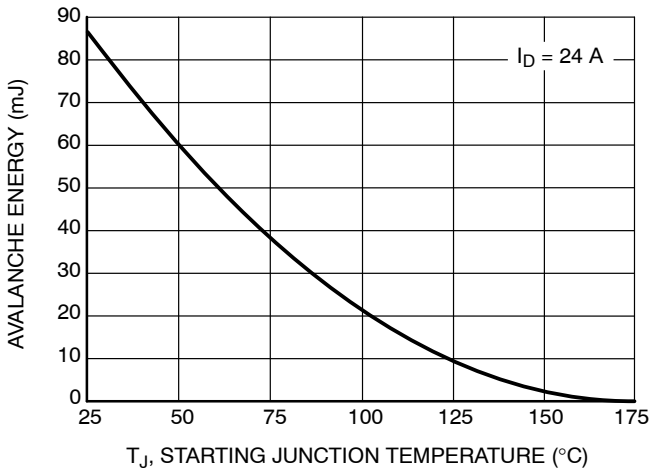



**Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature**

## TYPICAL PERFORMANCE CURVES

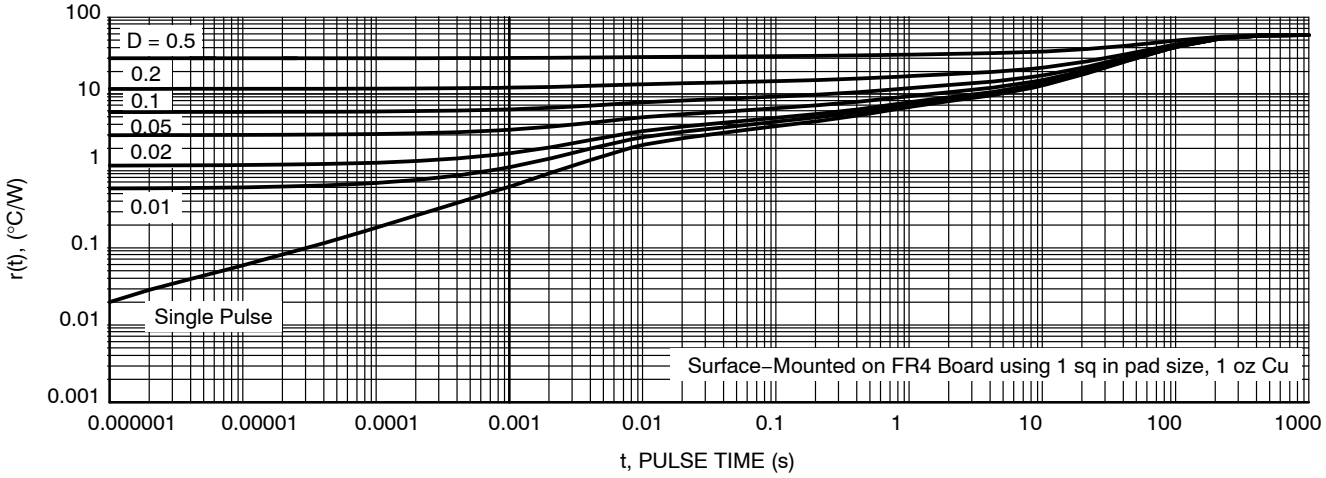
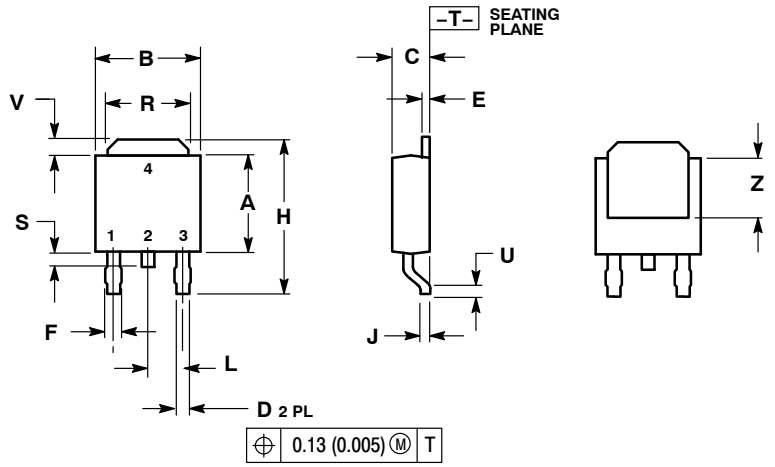



**Figure 13. Thermal Response**

## PACKAGE DIMENSIONS

**DPAK**
CASE 369AA−01
ISSUE A

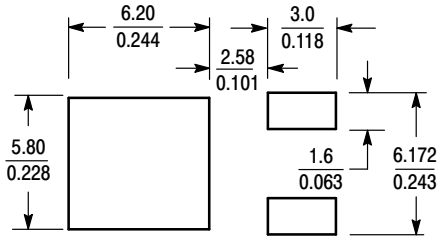



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

| | 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 $\left(\frac{\text{mm}}{\text{inches}}\right)$

*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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