

# NTD4959NH

## Power MOSFET

### 30 V, 58 A, Single N-Channel, DPAK/IPAK

#### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low Capacitance to Minimize Driver Losses
- Optimized Gate Charge to Minimize Switching Losses
- These are Pb-Free Devices

#### Applications

- CPU Power Delivery
- DC-DC Converters
- Low Side Switching

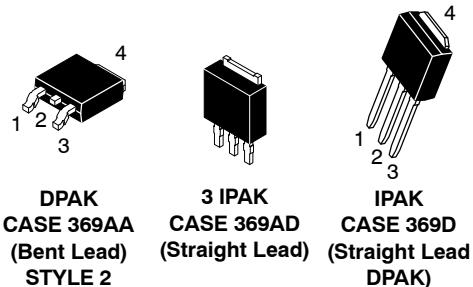
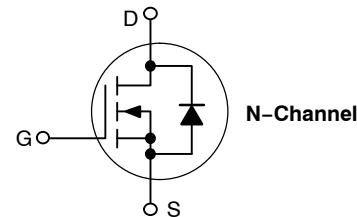
#### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Parameter  | Symbol         | Value      | Unit             |
|--|----------------|------------|------------------|
| Drain-to-Source Voltage  | $V_{DSS}$      | 30         | V                |
| Gate-to-Source Voltage   | $V_{GS}$       | $\pm 20$   | V                |
| Continuous Drain Current ( $R_{\theta JA}$ ) (Note 1)  | $I_D$          | 11.5       | A                |
|  |                | 9.0        |                  |
| Power Dissipation ( $R_{\theta JA}$ ) (Note 1)   | $P_D$          | 2.0        | W                |
|  |                |            |                  |
| Continuous Drain Current ( $R_{\theta JA}$ ) (Note 2)  | $I_D$          | 9.0        | A                |
|  |                | 7.0        |                  |
| Power Dissipation ( $R_{\theta JA}$ ) (Note 2)   | $P_D$          | 1.3        | W                |
|  |                |            |                  |
| Continuous Drain Current ( $R_{\theta JC}$ ) (Note 1)  | $I_D$          | 58         | A                |
|  |                | 45         |                  |
| Power Dissipation ( $R_{\theta JC}$ ) (Note 1)   | $P_D$          | 52         | W                |
|  |                |            |                  |
| Pulsed Drain Current $t_p = 10\mu\text{s}$   | $I_{DM}$       | 130        | A                |
| Current Limited by Package   | $I_{DmaxPkg}$  | 45         | A                |
| Operating Junction and Storage Temperature   | $T_J, T_{stg}$ | -55 to 175 | $^\circ\text{C}$ |
| Source Current (Body Diode)  | $I_S$          | 43         | A                |
| Drain to Source $dV/dt$  | $dV/dt$        | 6.0        | V/ns             |
| Single Pulse Drain-to-Source Avalanche Energy ( $V_{DD} = 24\text{ V}$ , $V_{GS} = 10\text{ V}$ , $L = 1.0\text{ mH}$ , $I_{L(pk)} = 15\text{ A}$ , $R_G = 25\text{ }\Omega$ ) | $E_{AS}$       | 112.5      | mJ               |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s)  | $T_L$          | 260        | $^\circ\text{C}$ |

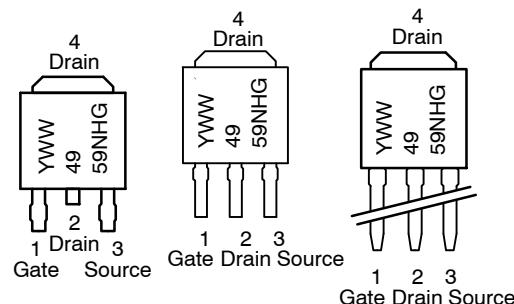
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

**ON****ON Semiconductor®**<http://onsemi.com>

| $V_{(BR)DSS}$ | $R_{DS(on)}\text{ MAX}$ | $I_D\text{ MAX}$ |
|---------------|-------------------------|------------------|
| 30 V          | 9.0 m $\Omega$ @ 10 V   | 58 A             |
|               | 12.5 m $\Omega$ @ 4.5 V |                  |



#### MARKING DIAGRAMS & PIN ASSIGNMENTS



Y = Year  
 WW = Work Week  
 4959NH = Device Code  
 G = Pb-Free Package

#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

## THERMAL RESISTANCE MAXIMUM RATINGS

| Parameter                                   | Symbol              | Value | Unit |
|---|---------------------|-------|------|
| Junction-to-Case (Drain)                    | $R_{\theta JC}$     | 2.9   | °C/W |
| Junction-to-TAB (Drain)                     | $R_{\theta JC-TAB}$ | 3.5   |      |
| Junction-to-Ambient – Steady State (Note 1) | $R_{\theta JA}$     | 74    |      |
| Junction-to-Ambient – Steady State (Note 2) | $R_{\theta JA}$     | 116   |      |

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

ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|-----------|--------|----------------|-----|-----|-----|------|
|-----------|--------|----------------|-----|-----|-----|------|

## OFF CHARACTERISTICS

|   |                          |  |                           |    |           |               |
|---|--------------------------|--|---------------------------|----|-----------|---------------|
| Drain-to-Source Breakdown Voltage                         | $V_{(\text{BR})DSS}$     | $V_{GS} = 0 \text{ V}$ , $I_D = 250 \mu\text{A}$     | 30                        |    |           | V             |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(\text{BR})DSS}/T_J$ |  |                           | 25 |           | mV/°C         |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$                | $V_{GS} = 0 \text{ V}$ ,<br>$V_{DS} = 24 \text{ V}$  | $T_J = 25^\circ\text{C}$  |    | 1.0       | $\mu\text{A}$ |
|   |                          |  | $T_J = 125^\circ\text{C}$ |    | 10        |               |
| Gate-to-Source Leakage Current                            | $I_{GSS}$                | $V_{DS} = 0 \text{ V}$ , $V_{GS} = \pm 20 \text{ V}$ |                           |    | $\pm 100$ | nA            |

## ON CHARACTERISTICS (Note 3)

|  |                         |  |                      |     |       |       |    |
|--|-------------------------|--|----------------------|-----|-------|-------|----|
| Gate Threshold Voltage                     | $V_{GS(\text{TH})}$     | $V_{GS} = V_{DS}$ , $I_D = 250 \mu\text{A}$    | 1.5                  | 2.1 | 2.5   | V     |    |
| Negative Threshold Temperature Coefficient | $V_{GS(\text{TH})}/T_J$ |  |                      | 5.7 |       | mV/°C |    |
| Drain-to-Source On Resistance              | $R_{DS(\text{on})}$     | $V_{GS} = 10 \text{ to } 11.5 \text{ V}$       | $I_D = 30 \text{ A}$ |     | 7.0   | 9.0   | mΩ |
|  |                         |  | $I_D = 15 \text{ A}$ |     | 7.0   |       |    |
|  |                         | $V_{GS} = 4.5 \text{ V}$                       | $I_D = 30 \text{ A}$ |     | 10.45 | 12.5  |    |
|  |                         |  | $I_D = 15 \text{ A}$ |     | 9.95  |       |    |
| Forward Transconductance                   | $g_{FS}$                | $V_{DS} = 15 \text{ V}$ , $I_D = 15 \text{ A}$ |                      | 9.0 |       | S     |    |

## CHARGES AND CAPACITANCES

|                              |                     |   |  |      |      |    |
|------------------------------|---------------------|---|--|------|------|----|
| Input Capacitance            | $C_{iss}$           | $V_{GS} = 0 \text{ V}$ , $f = 1.0 \text{ MHz}$ ,<br>$V_{DS} = 12 \text{ V}$   |  | 1596 | 2155 | pF |
| Output Capacitance           | $C_{oss}$           |   |  | 331  | 447  |    |
| Reverse Transfer Capacitance | $C_{rss}$           |   |  | 190  | 294  |    |
| Total Gate Charge            | $Q_{G(\text{TOT})}$ | $V_{GS} = 4.5 \text{ V}$ , $V_{DS} = 15 \text{ V}$ ,<br>$I_D = 30 \text{ A}$  |  | 12.5 | 15   | nC |
| Threshold Gate Charge        | $Q_{G(\text{TH})}$  |   |  | 2.4  | 3.6  |    |
| Gate-to-Source Charge        | $Q_{GS}$            |   |  | 5.3  | 7.9  |    |
| Gate-to-Drain Charge         | $Q_{GD}$            |   |  | 5.1  | 7.7  |    |
| Total Gate Charge            | $Q_{G(\text{TOT})}$ | $V_{GS} = 11.5 \text{ V}$ , $V_{DS} = 15 \text{ V}$ ,<br>$I_D = 30 \text{ A}$ |  | 29.3 | 44   | nC |

## SWITCHING CHARACTERISTICS (Note 4)

|                     |                     |  |  |      |      |    |
|---------------------|---------------------|--|--|------|------|----|
| Turn-On Delay Time  | $t_{d(\text{on})}$  | $V_{GS} = 4.5 \text{ V}$ , $V_{DS} = 15 \text{ V}$ ,<br>$I_D = 15 \text{ A}$ , $R_G = 3.0 \Omega$  |  | 12.0 | 18   | ns |
| Rise Time           | $t_r$               |  |  | 20   | 30   |    |
| Turn-Off Delay Time | $t_{d(\text{off})}$ |  |  | 14   | 21   |    |
| Fall Time           | $t_f$               |  |  | 5.0  | 7.5  |    |
| Turn-On Delay Time  | $t_{d(\text{on})}$  | $V_{GS} = 11.5 \text{ V}$ , $V_{DS} = 15 \text{ V}$ ,<br>$I_D = 15 \text{ A}$ , $R_G = 3.0 \Omega$ |  | 7.0  | 10.4 | ns |
| Rise Time           | $t_r$               |  |  | 18   | 27   |    |
| Turn-Off Delay Time | $t_{d(\text{off})}$ |  |  | 22   | 33   |    |
| Fall Time           | $t_f$               |  |  | 3.0  | 4.6  |    |

3. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .
4. Switching characteristics are independent of operating junction temperatures.

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ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|-----------|--------|----------------|-----|-----|-----|------|
|-----------|--------|----------------|-----|-----|-----|------|

## DRAIN-SOURCE DIODE CHARACTERISTICS

|                       |          |  |                           |  |      |     |    |
|-----------------------|----------|--|---------------------------|--|------|-----|----|
| Forward Diode Voltage | $V_{SD}$ | $V_{GS} = 0 \text{ V}$ ,<br>$I_S = 30 \text{ A}$   | $T_J = 25^\circ\text{C}$  |  | 0.95 | 1.2 | V  |
|                       |          |  | $T_J = 125^\circ\text{C}$ |  | 0.83 |     |    |
| Reverse Recovery Time | $t_{RR}$ | $V_{GS} = 0 \text{ V}$ , $dI_S/dt = 100 \text{ A}/\mu\text{s}$ ,<br>$I_S = 30 \text{ A}$ |                           |  | 15.6 |     | ns |
| Charge Time           | $t_a$    |  |                           |  | 10.6 |     |    |
| Discharge Time        | $t_b$    |  |                           |  | 5.0  |     |    |
| Reverse Recovery Time | $Q_{RR}$ |  |                           |  | 7.5  |     | nC |

## PACKAGE PARASITIC VALUES

|                        |       |                          |  |        |  |          |
|------------------------|-------|--------------------------|--|--------|--|----------|
| Source Inductance      | $L_S$ | $T_A = 25^\circ\text{C}$ |  | 2.49   |  | nH       |
| Drain Inductance, DPAK | $L_D$ |                          |  | 0.0164 |  |          |
| Drain Inductance, IPAK | $L_D$ |                          |  | 1.88   |  |          |
| Gate Inductance        | $L_G$ |                          |  | 3.46   |  |          |
| Gate Resistance        | $R_G$ |                          |  | 0.75   |  | $\Omega$ |

## TYPICAL PERFORMANCE CURVES

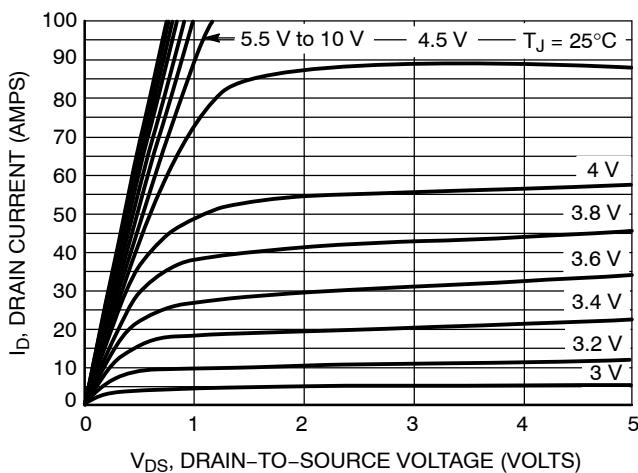


Figure 1. On-Region Characteristics

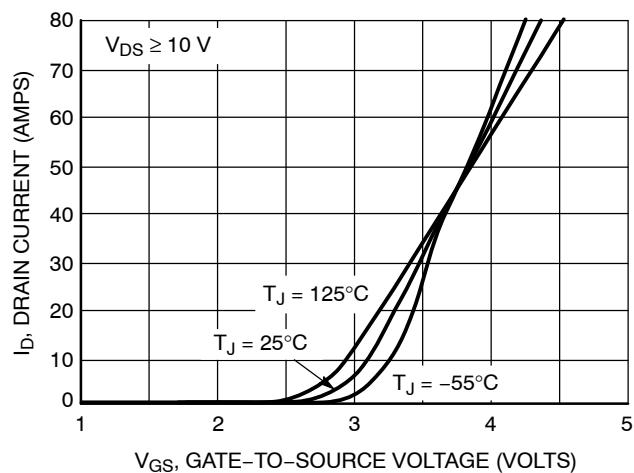


Figure 2. Transfer Characteristics

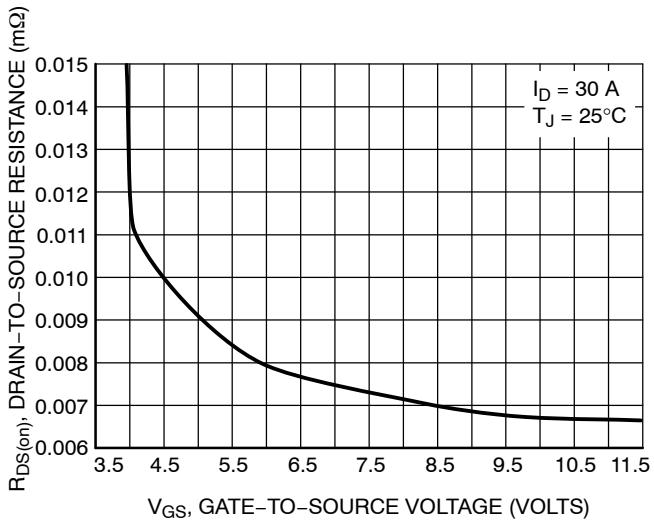


Figure 3. On-Resistance vs. Gate-to-Source Voltage

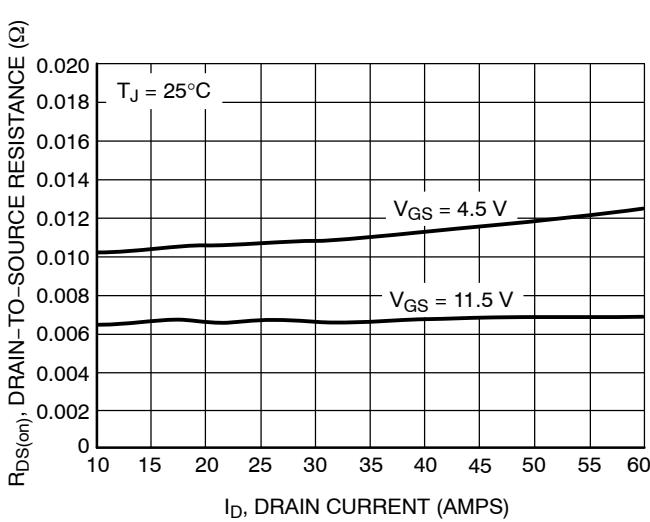


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

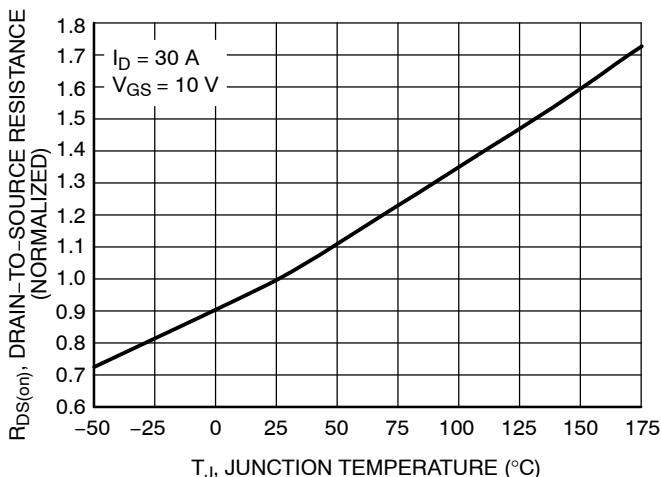


Figure 5. On-Resistance Variation with Temperature

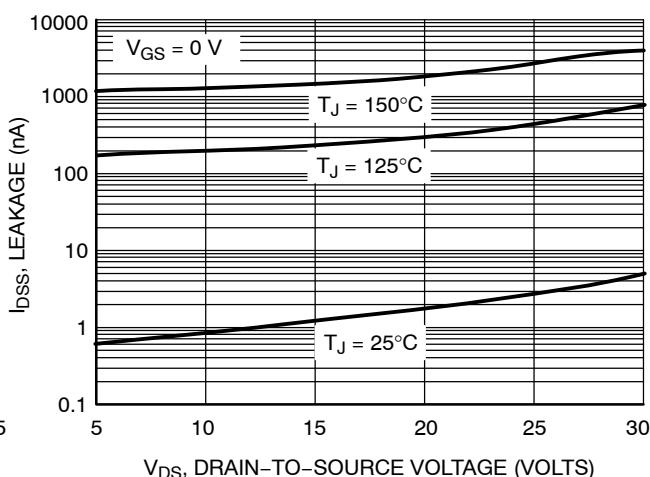
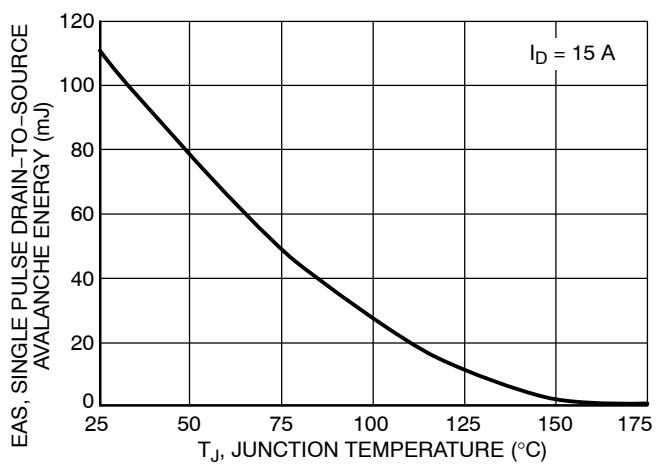
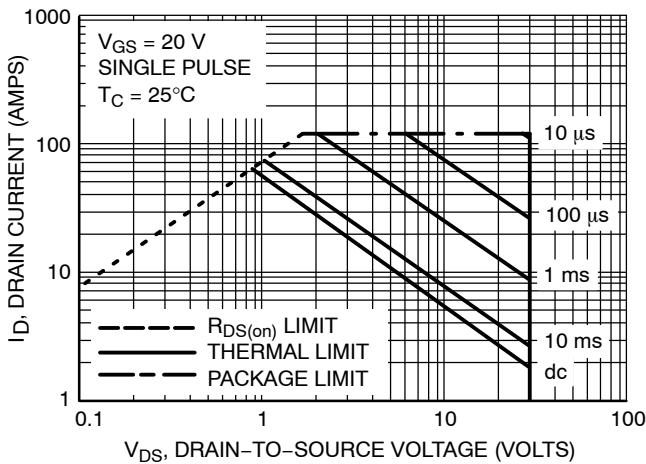
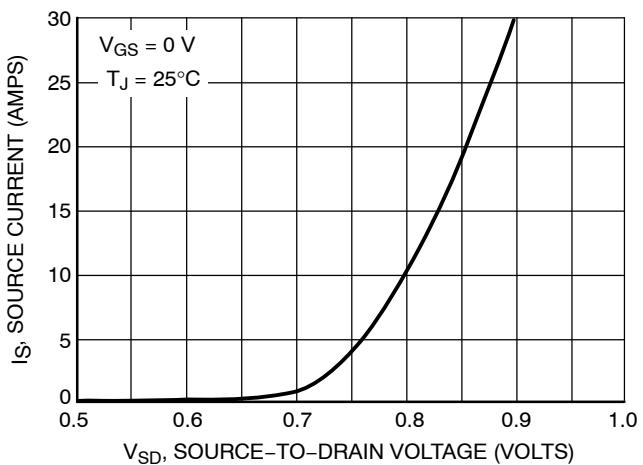
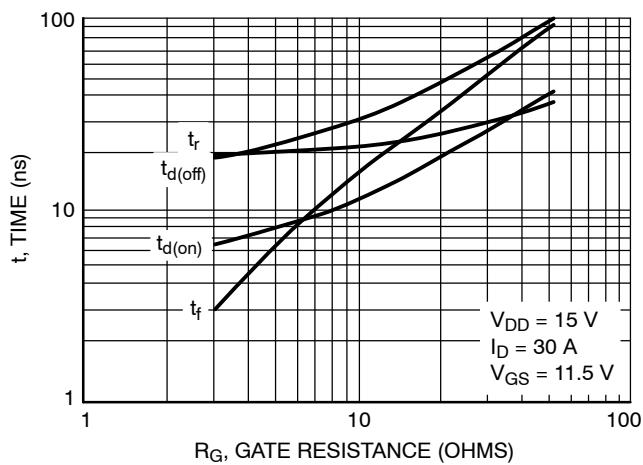
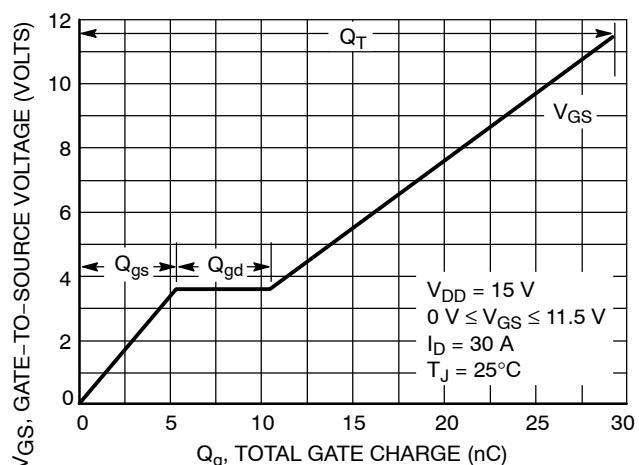
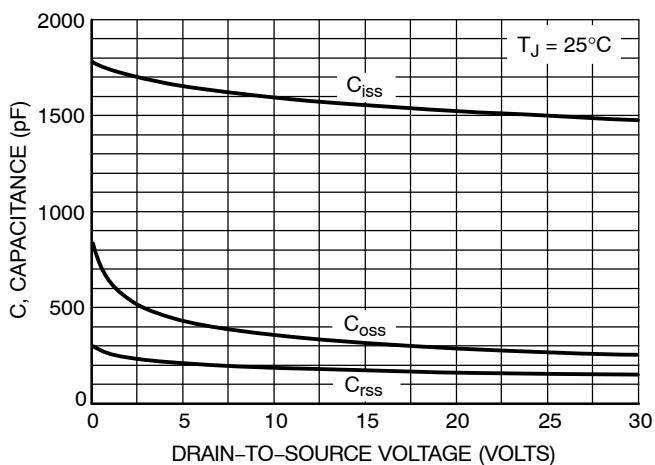


Figure 6. Drain-to-Source Leakage Current vs. Drain Voltage

## TYPICAL PERFORMANCE CURVES



## TYPICAL PERFORMANCE CURVES

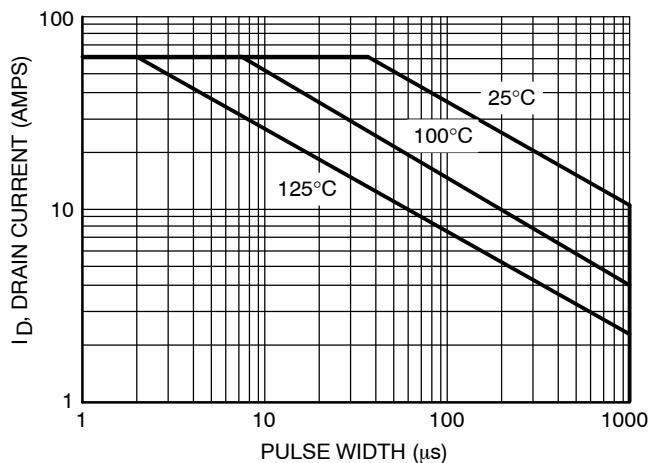


Figure 13. Avalanche Characteristics

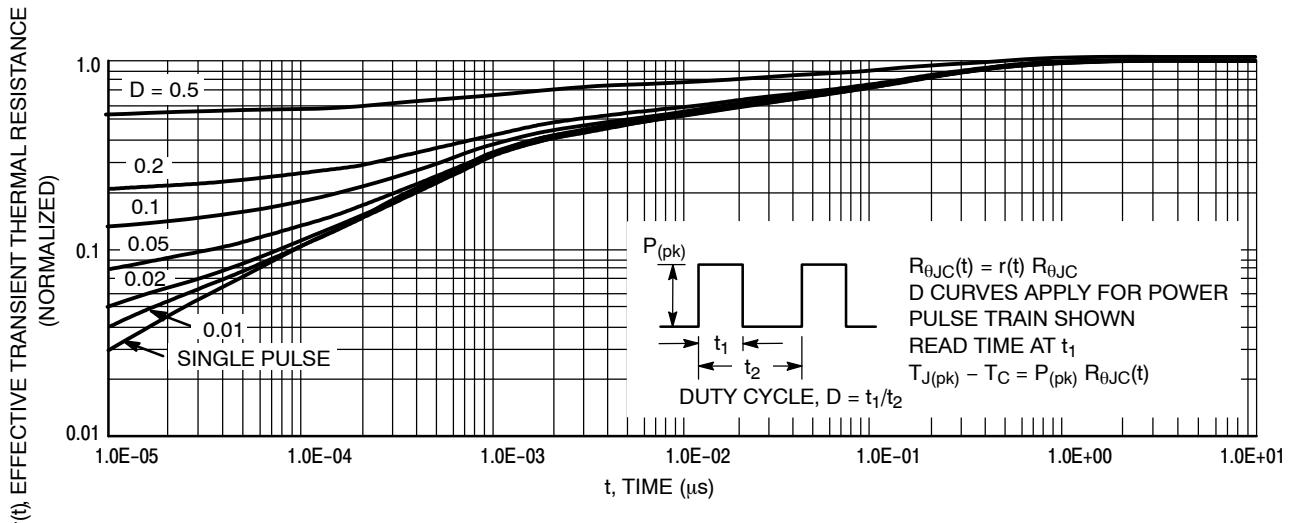


Figure 14. Thermal Response

## ORDERING INFORMATION

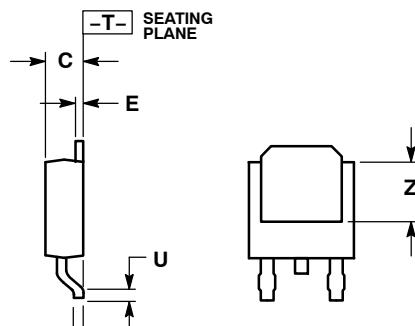
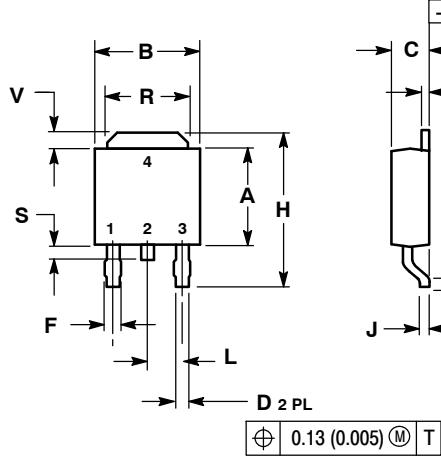
| Device        | Package  | Shipping <sup>†</sup> |
|---------------|--|-----------------------|
| NTD4959NHT4G  | DPAK<br>(Pb-Free)                                      | 2500 / Tape & Reel    |
| NTD4959NH-1G  | IPAK<br>(Pb-Free)                                      | 75 Units / Rail       |
| NTD4959NH-35G | IPAK Trimmed Lead<br>( $3.5 \pm 0.15$ mm)<br>(Pb-Free) | 75 Units / Rail       |

<sup>†</sup>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.

# NTD4959NH

## PACKAGE DIMENSIONS

### DPAK (SINGLE GAUGE) CASE 369AA-01 ISSUE A

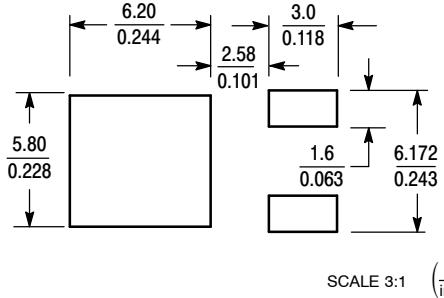


NOTES:  
1. DIMENSIONING AND TOLERANCING  
PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | 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

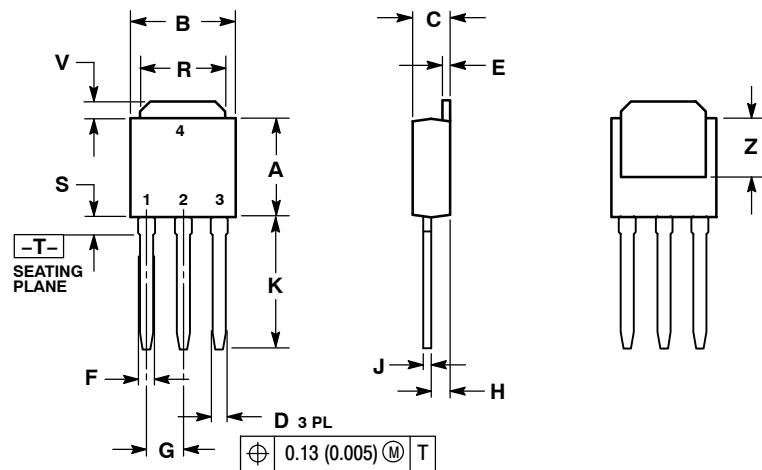
### SOLDERING FOOTPRINT\*



SCALE 3:1 (mm/inches)

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

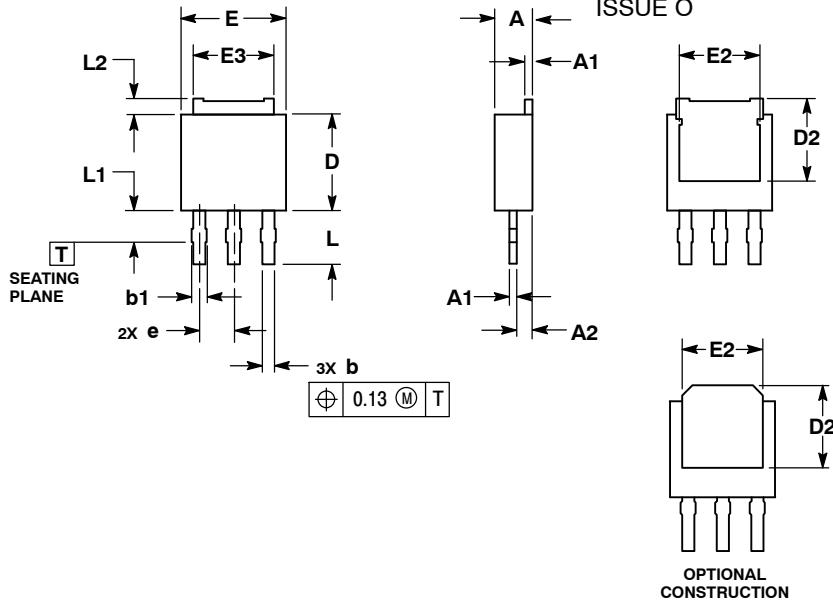
## PACKAGE DIMENSIONS

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

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

| DIM | INCHES |       | MILLIMETERS |      |
|-----|--------|-------|-------------|------|
|     | 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:  
 1. GATE  
 2. DRAIN  
 3. SOURCE  
 4. DRAIN

3.5 MM IPAK, STRAIGHT LEAD  
CASE 369AD-01  
ISSUE O

NOTES:  
 1.. DIMENSIONING AND TOLERANCING PER  
 ASME Y14.5M, 1994.  
 2.. CONTROLLING DIMENSION: MILLIMETERS.  
 3.. DIMENSION b APPLIES TO PLATED TERMINAL  
 AND IS MEASURED BETWEEN 0.15 AND  
 0.30mm FROM TERMINAL TIP.  
 4.. DIMENSIONS D AND E DO NOT INCLUDE  
 MOLD GATE OR MOLD FLASH.

| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN         | MAX  |
| A   | 2.19        | 2.38 |
| A1  | 0.46        | 0.60 |
| A2  | 0.87        | 1.10 |
| b   | 0.69        | 0.89 |
| b1  | 0.77        | 1.10 |
| D   | 5.97        | 6.22 |
| D2  | 4.80        | ---  |
| E   | 6.35        | 6.73 |
| E2  | 4.70        | ---  |
| E3  | 4.45        | 5.46 |
| e   | 2.28        | BSC  |
| L   | 3.40        | 3.60 |
| L1  | ---         | 2.10 |
| L2  | 0.89        | 1.27 |

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