

# NTD2955, NTD2955P, NVD2955

## Power MOSFET

-60 V, -12 A, P-Channel DPAK

This Power MOSFET is designed to withstand high energy in the avalanche and commutation modes. Designed for low-voltage, high-speed switching applications in power supplies, converters, and power motor controls. These devices are particularly well suited for bridge circuits where diode speed and commutating safe operating areas are critical and offer an additional safety margin against unexpected voltage transients.

### Features

- Avalanche Energy Specified
- $I_{DSS}$  and  $V_{DS(on)}$  Specified at Elevated Temperature
- Designed for Low-Voltage, High-Speed Switching Applications and to Withstand High Energy in the Avalanche and Commutation Modes
- NVD Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant

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

| Rating  | Symbol          | Value      | Unit                      |
|---|-----------------|------------|---------------------------|
| Drain-to-Source Voltage   | $V_{DSS}$       | -60        | Vdc                       |
| Gate-to-Source Voltage  | $V_{GS}$        | $\pm 20$   | Vdc                       |
| - Continuous  | $V_{GSM}$       | $\pm 25$   | Vpk                       |
| - Non-repetitive ( $t_p \leq 10$ ms)  |                 |            |                           |
| Drain Current   | $I_D$           | -12        | Adc                       |
| - Continuous @ $T_a = 25^\circ\text{C}$   | $I_{DM}$        | -18        | Apk                       |
| - Single Pulse ( $t_p \leq 10$ ms)  |                 |            |                           |
| Total Power Dissipation @ $T_a = 25^\circ\text{C}$  | $P_D$           | 55         | W                         |
| Operating and Storage Temperature Range   | $T_J, T_{stg}$  | -55 to 175 | $^\circ\text{C}$          |
| Single Pulse Drain-to-Source Avalanche Energy - Starting $T_J = 25^\circ\text{C}$<br>( $V_{DD} = 25$ Vdc, $V_{GS} = 10$ Vdc, Peak $I_L = 12$ Apk, $L = 3.0$ mH, $R_G = 25$ $\Omega$ ) | $E_{AS}$        | 216        | mJ                        |
| Thermal Resistance  |                 |            | $^\circ\text{C}/\text{W}$ |
| - Junction-to-Case  | $R_{\theta JC}$ | 2.73       |                           |
| - Junction-to-Ambient (Note 1)  | $R_{\theta JA}$ | 71.4       |                           |
| - Junction-to-Ambient (Note 2)  | $R_{\theta JA}$ | 100        |                           |
| Maximum Lead Temperature for Soldering Purposes, 1/8 in. from case for 10 seconds   | $T_L$           | 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.

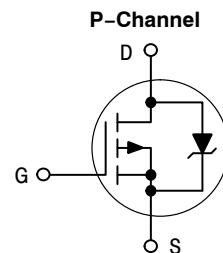
1. When surface mounted to an FR4 board using 1 in pad size (Cu area = 1.127 in<sup>2</sup>).
2. When surface mounted to an FR4 board using the minimum recommended pad size (Cu area = 0.412 in<sup>2</sup>).



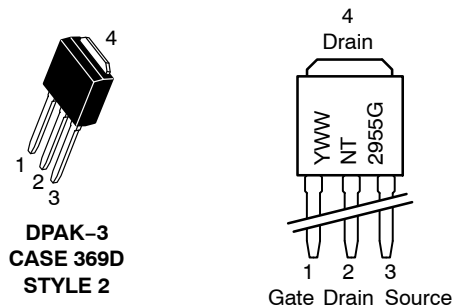
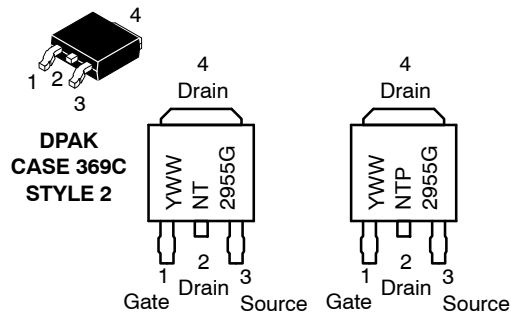
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| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP            | $I_D$ MAX |
|---------------|-----------------------------|-----------|
| -60 V         | 155 m $\Omega$ @ -10 V, 6 A | -12 A     |



### MARKING DIAGRAMS



Y = Year  
WW = Work Week  
G = Pb-Free Package

### ORDERING INFORMATION

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

# NTD2955, NTD2955P, NVD2955

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|  |                      |          |         |             |              |
|--|----------------------|----------|---------|-------------|--------------|
| Drain-to-Source Breakdown Voltage (Note 3)<br>(V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = -0.25 mA)<br>(Positive Temperature Coefficient)   | V <sub>(BR)DSS</sub> | -60<br>- | -<br>67 | -<br>-      | Vdc<br>mV/°C |
| Zero Gate Voltage Drain Current<br>(V <sub>GS</sub> = 0 Vdc, V <sub>DS</sub> = -60 Vdc, T <sub>J</sub> = 25°C)<br>(V <sub>GS</sub> = 0 Vdc, V <sub>DS</sub> = -60 Vdc, T <sub>J</sub> = 150°C) | I <sub>DSS</sub>     | -<br>-   | -<br>-  | -10<br>-100 | μAdc         |
| Gate-Body Leakage Current (V <sub>GS</sub> = ± 20 Vdc, V <sub>DS</sub> = 0 Vdc)  | I <sub>GSS</sub>     | -        | -       | -100        | nAdc         |

### ON CHARACTERISTICS (Note 3)

|   |                     |           |             |              |              |
|---|---------------------|-----------|-------------|--------------|--------------|
| Gate Threshold Voltage<br>(V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μAdc)<br>(Negative Temperature Coefficient)                                      | V <sub>GS(th)</sub> | -2.0<br>- | -2.8<br>4.5 | -4.0<br>-    | Vdc<br>mV/°C |
| Static Drain-Source On-State Resistance<br>(V <sub>GS</sub> = -10 Vdc, I <sub>D</sub> = -6.0 Adc)   | R <sub>DS(on)</sub> | -         | 0.155       | 0.180        | Ω            |
| Drain-to-Source On-Voltage<br>(V <sub>GS</sub> = -10 Vdc, I <sub>D</sub> = -12 Adc)<br>(V <sub>GS</sub> = -10 Vdc, I <sub>D</sub> = -6.0 Adc, T <sub>J</sub> = 150°C) | V <sub>DS(on)</sub> |           | -1.86<br>-  | -2.6<br>-2.0 | Vdc          |
| Forward Transconductance (V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 6.0 Adc)   | g <sub>FS</sub>     |           | 8.0         | -            | Mhos         |

### DYNAMIC CHARACTERISTICS

|                              |  |                  |   |     |     |    |
|------------------------------|--|------------------|---|-----|-----|----|
| Input Capacitance            | (V <sub>DS</sub> = -25 Vdc, V <sub>GS</sub> = 0 Vdc,<br>F = 1.0 MHz) | C <sub>iSS</sub> | - | 500 | 750 | pF |
| Output Capacitance           |  | C <sub>oss</sub> | - | 150 | 250 |    |
| Reverse Transfer Capacitance |  | C <sub>rSS</sub> | - | 50  | 100 |    |

### SWITCHING CHARACTERISTICS (Notes 3 and 4)

|                     |   |                     |   |     |    |    |
|---------------------|---|---------------------|---|-----|----|----|
| Turn-On Delay Time  | (V <sub>DD</sub> = -30 Vdc, I <sub>D</sub> = -12 A,<br>V <sub>GS</sub> = -10 V, R <sub>G</sub> = 9.1 Ω) | t <sub>d(on)</sub>  | - | 10  | 20 | ns |
| Rise Time           |   | t <sub>r</sub>      | - | 45  | 85 |    |
| Turn-Off Delay Time |   | t <sub>d(off)</sub> | - | 26  | 40 |    |
| Fall Time           |   | t <sub>f</sub>      | - | 48  | 90 |    |
| Gate Charge         | (V <sub>DS</sub> = -48 Vdc, V <sub>GS</sub> = -10 Vdc,<br>I <sub>D</sub> = -12 A)                       | Q <sub>T</sub>      | - | 15  | 30 | nC |
|                     |   | Q <sub>GS</sub>     | - | 4.0 | -  |    |
|                     |   | Q <sub>GD</sub>     | - | 7.0 | -  |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS (Note 3)

|  |                 |        |              |           |     |
|--|-----------------|--------|--------------|-----------|-----|
| Diode Forward On-Voltage<br>(I <sub>S</sub> = 12 Adc, V <sub>GS</sub> = 0 V)<br>(I <sub>S</sub> = 12 Adc, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150°C) | V <sub>SD</sub> | -<br>- | -1.6<br>-1.3 | -2.5<br>- | Vdc |
| Reverse Recovery Time<br>(I <sub>S</sub> = 12 A, di <sub>S</sub> /dt = 100 A/μs, V <sub>GS</sub> = 0 V)  | t <sub>rr</sub> | -      | 50           |           | ns  |
|  | t <sub>a</sub>  | -      | 40           | -         |     |
|  | t <sub>b</sub>  | -      | 10           | -         |     |
| Reverse Recovery Stored Charge   | Q <sub>RR</sub> | -      | 0.10         | -         | μC  |

3. Indicates Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

4. Switching characteristics are independent of operating junction temperature.

# NTD2955, NTD2955P, NVD2955

## TYPICAL PERFORMANCE CURVES ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

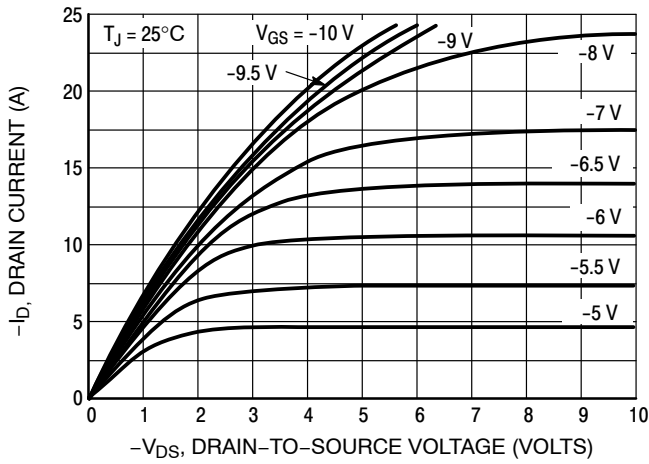


Figure 1. On-Region Characteristics

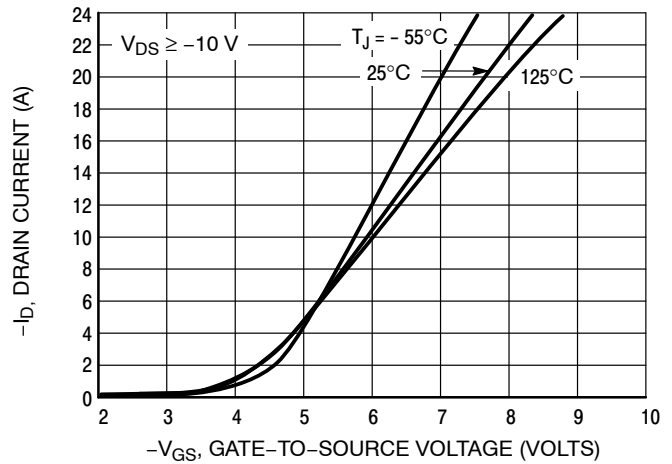


Figure 2. Transfer Characteristics

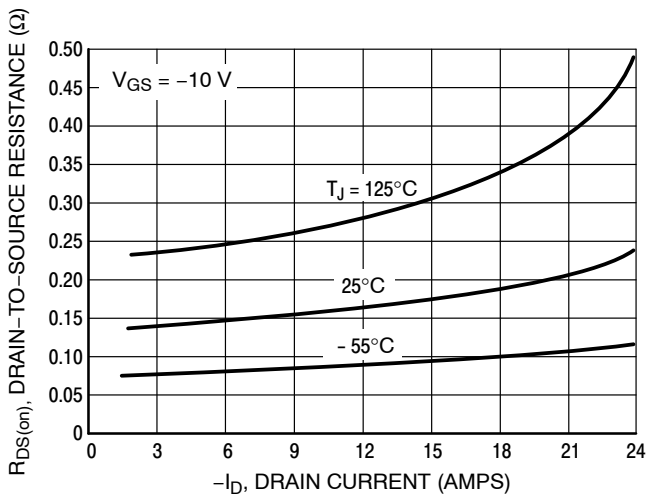


Figure 3. On-Resistance versus Drain Current and Temperature

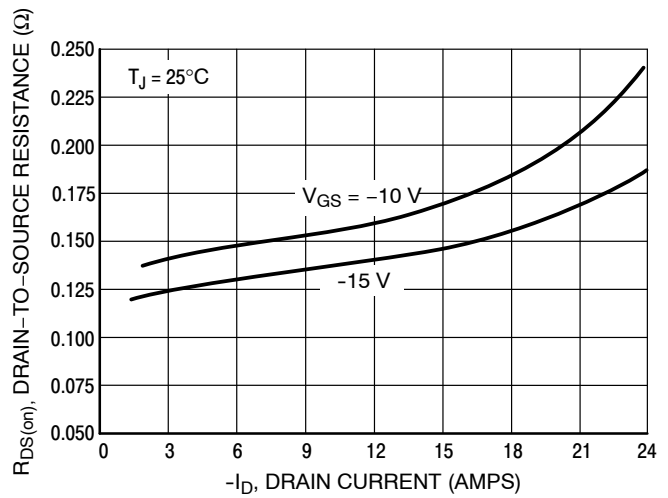


Figure 4. On-Resistance versus Drain Current and Gate Voltage

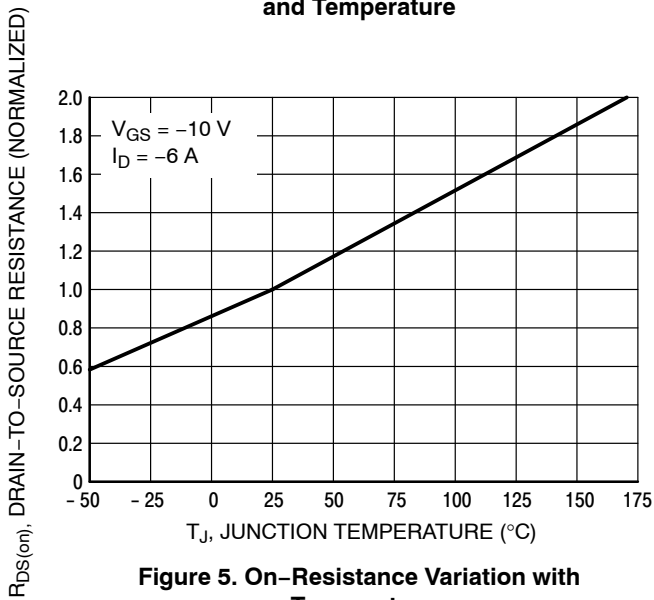


Figure 5. On-Resistance Variation with Temperature

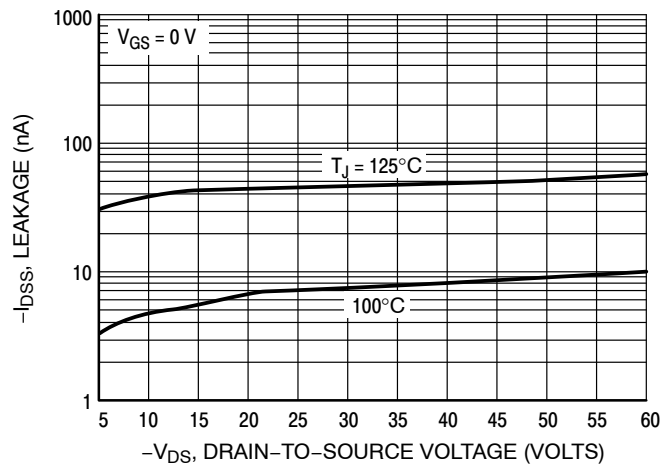


Figure 6. Drain-To-Source Leakage Current versus Voltage

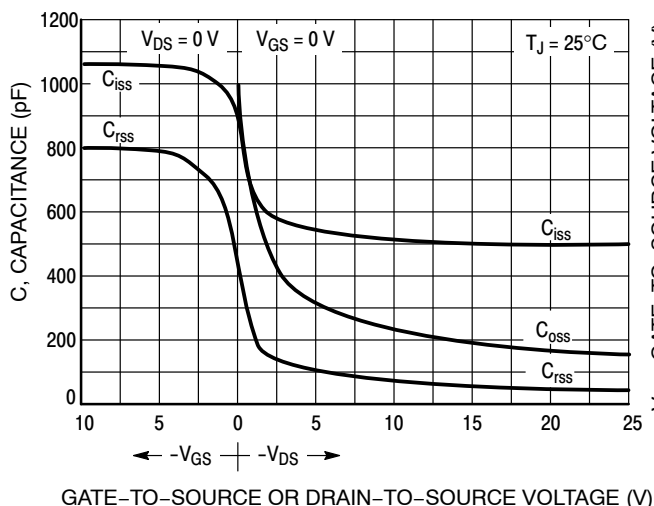


Figure 7. Capacitance Variation

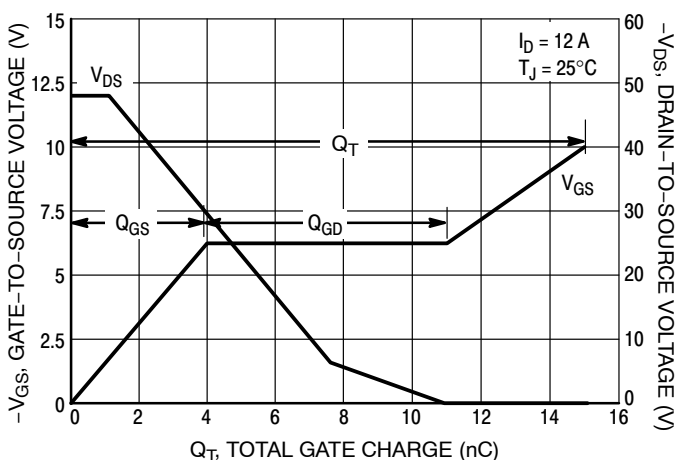


Figure 8. Gate-To-Source and Drain-To-Source Voltage versus Total Charge

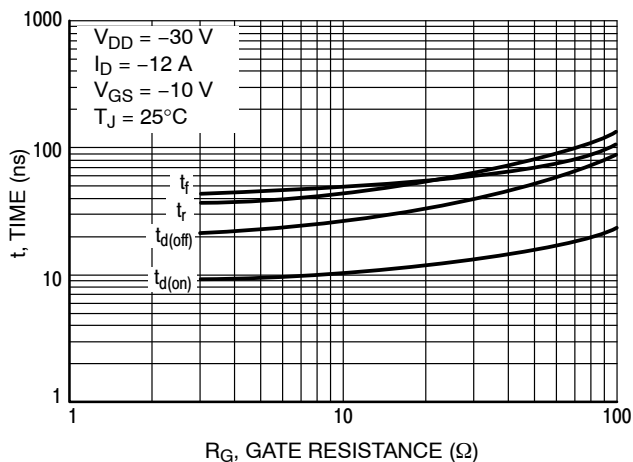


Figure 9. Resistive Switching Time Variation versus Gate Resistance

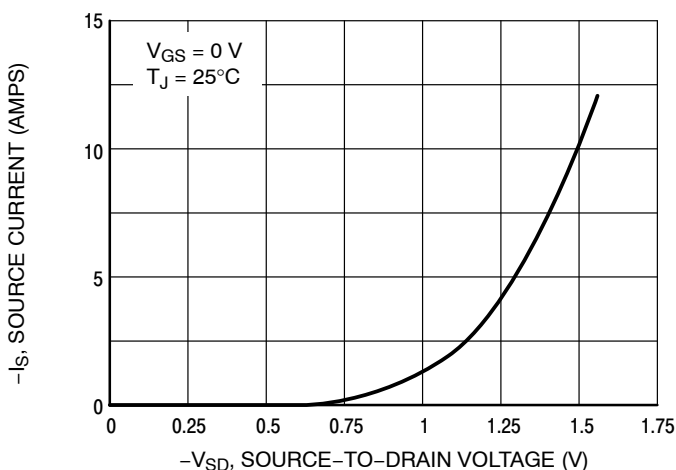


Figure 10. Diode Forward Voltage versus Current

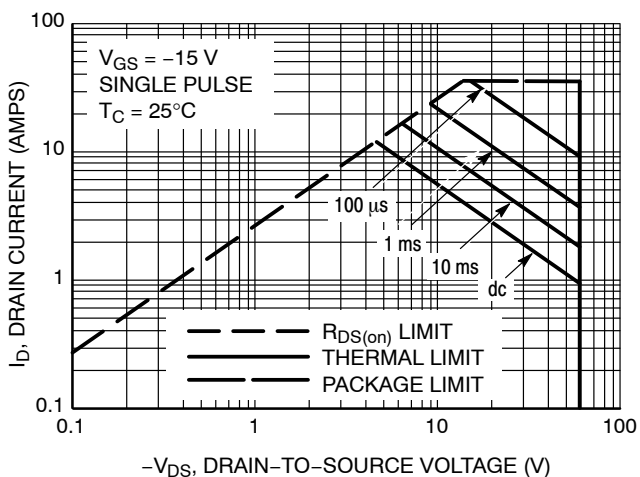


Figure 11. Maximum Rated Forward Biased Safe Operating Area

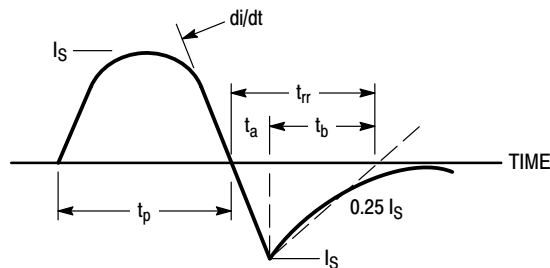


Figure 12. Diode Reverse Recovery Waveform

# NTD2955, NTD2955P, NVD2955

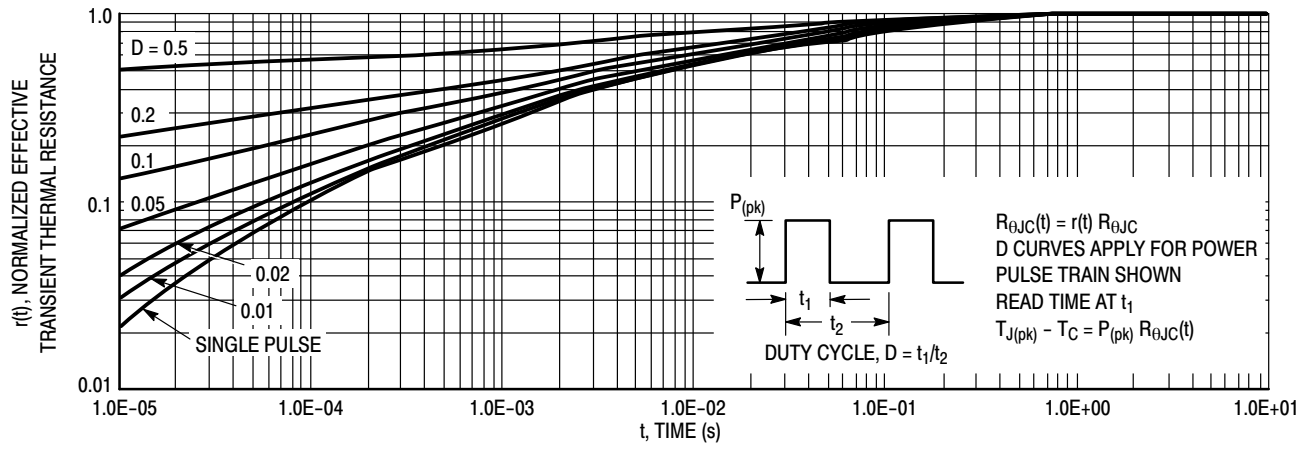


Figure 13. Thermal Response

## NTD2955, NTD2955P, NVD2955

### ORDERING INFORMATION

| Device      | Package           | Shipping†          |
|-------------|-------------------|--------------------|
| NTD2955G    | DPAK<br>(Pb-Free) | 75 Units / Rail    |
| NTD2955-1G  | IPAK<br>(Pb-Free) | 75 Units / Rail    |
| NTD2955T4G  | DPAK<br>(Pb-Free) | 2500 / Tape & Reel |
| NTD2955PT4G | DPAK<br>(Pb-Free) |                    |
| NVD2955T4G* | DPAK<br>(Pb-Free) |                    |

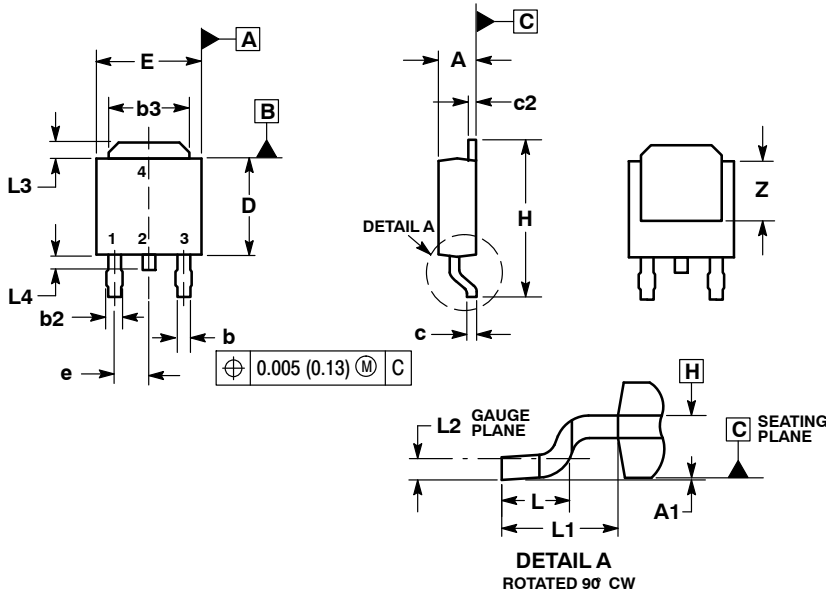
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

\*NVD Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.

# NTD2955, NTD2955P, NVD2955

## PACKAGE DIMENSIONS

### DPAK (SINGLE GAUGE) CASE 369C ISSUE D

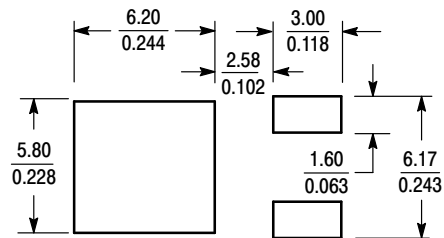


**NOTES:**

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.

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

### SOLDERING FOOTPRINT\*



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

**STYLE 2:**

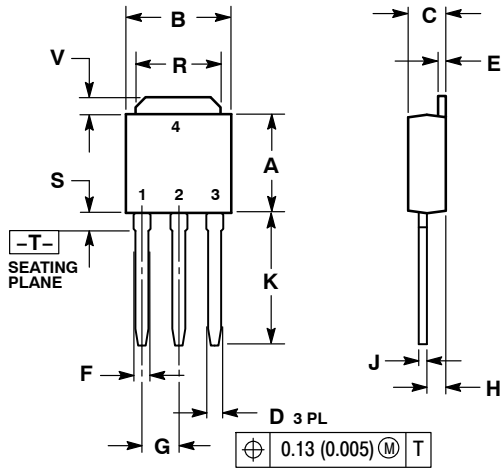
- PIN 1. GATE
- DRAIN
- SOURCE
- DRAIN

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

# NTD2955, NTD2955P, NVD2955

## PACKAGE DIMENSIONS

### IPAK CASE 369D ISSUE C

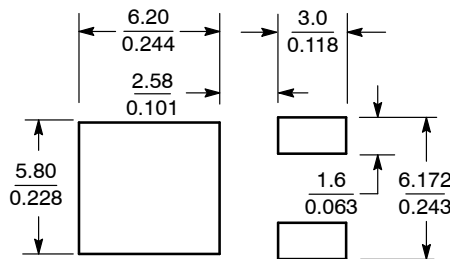


- NOTES:  
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
 2. CONTROLLING DIMENSION: INCH.

| 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:  
 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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