

# NTD2955, 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  | $R_{\theta JC}$ | 2.73       | $^\circ\text{C/W}$ |
| - Junction-to-Case  | $R_{\theta JA}$ | 71.4       |                    |
| - Junction-to-Ambient (Note 1)  | $R_{\theta JA}$ | 100        |                    |
| - Junction-to-Ambient (Note 2)  |                 |            |                    |
| Maximum Lead Temperature for Soldering Purposes, 1/8 in. from case for 10 seconds   | $T_L$           | 260        | $^\circ\text{C}$   |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

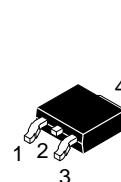
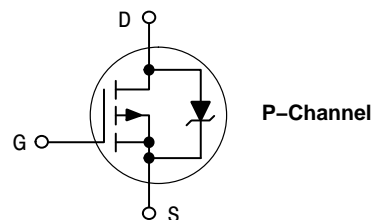
1. When surface mounted to an FR4 board using 1 in pad size (Cu area = 1.127 in<sup>2</sup>).
2. When surface mounted to an FR4 board using the minimum recommended pad size (Cu area = 0.412 in<sup>2</sup>).



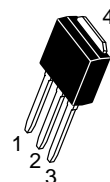
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<http://onsemi.com>

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

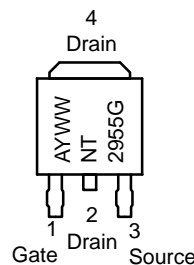


**DPAK**  
CASE 369C  
STYLE 2

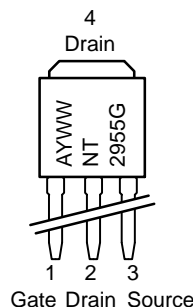


**IPAK**  
CASE 369D  
STYLE 2

### MARKING DIAGRAMS & PIN ASSIGNMENTS



Gate Drain Source



Gate Drain Source

A = Assembly Location\*  
 NT2955/NTP2955 = Device Code (DPAK)  
 NT2955 = Device Code (IPAK)  
 Y = Year  
 WW = Work Week  
 G = Pb-Free Package

\* The Assembly Location code (A) is front side optional. In cases where the Assembly Location is stamped in the package, the front side assembly code may be blank.

### ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

# NTD2955, NVD2955

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

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

### OFF CHARACTERISTICS

|  |               |          |         |             |                             |
|--|---------------|----------|---------|-------------|-----------------------------|
| Drain-to-Source Breakdown Voltage (Note 3)<br>( $V_{GS} = 0\text{ Vdc}$ , $I_D = -0.25\text{ mA}$ )<br>(Positive Temperature Coefficient)  | $V_{(BR)DSS}$ | -60<br>- | -<br>67 | -<br>-      | Vdc<br>mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current<br>( $V_{GS} = 0\text{ Vdc}$ , $V_{DS} = -60\text{ Vdc}$ , $T_J = 25^\circ\text{C}$ )<br>( $V_{GS} = 0\text{ Vdc}$ , $V_{DS} = -60\text{ Vdc}$ , $T_J = 150^\circ\text{C}$ ) | $I_{DSS}$     | -<br>-   | -<br>-  | -10<br>-100 | $\mu\text{Adc}$             |
| Gate-Body Leakage Current ( $V_{GS} = \pm 20\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )   | $I_{GSS}$     | -        | -       | -100        | nAdc                        |

### ON CHARACTERISTICS (Note 3)

|   |              |           |             |              |                             |
|---|--------------|-----------|-------------|--------------|-----------------------------|
| Gate Threshold Voltage<br>( $V_{DS} = V_{GS}$ , $I_D = -250\ \mu\text{Adc}$ )<br>(Negative Temperature Coefficient)   | $V_{GS(th)}$ | -2.0<br>- | -2.8<br>4.5 | -4.0<br>-    | Vdc<br>mV/ $^\circ\text{C}$ |
| Static Drain-Source On-State Resistance<br>( $V_{GS} = -10\text{ Vdc}$ , $I_D = -6.0\text{ Adc}$ )  | $R_{DS(on)}$ | -         | 0.155       | 0.180        | $\Omega$                    |
| Drain-to-Source On-Voltage<br>( $V_{GS} = -10\text{ Vdc}$ , $I_D = -12\text{ Adc}$ )<br>( $V_{GS} = -10\text{ Vdc}$ , $I_D = -6.0\text{ Adc}$ , $T_J = 150^\circ\text{C}$ ) | $V_{DS(on)}$ |           | -1.86<br>-  | -2.6<br>-2.0 | Vdc                         |
| Forward Transconductance ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 6.0\text{ Adc}$ )  | gFS          |           | 8.0         | -            | Mhos                        |

### DYNAMIC CHARACTERISTICS

|                              |  |           |   |     |     |    |
|------------------------------|--|-----------|---|-----|-----|----|
| Input Capacitance            | $(V_{DS} = -25\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ ,<br>$F = 1.0\text{ MHz}$ ) | $C_{iss}$ | - | 500 | 750 | pF |
| Output Capacitance           |  | $C_{oss}$ | - | 150 | 250 |    |
| Reverse Transfer Capacitance |  | $C_{rss}$ | - | 50  | 100 |    |

### SWITCHING CHARACTERISTICS (Notes 3 and 4)

|                     |  |              |   |     |    |    |
|---------------------|--|--------------|---|-----|----|----|
| Turn-On Delay Time  | $(V_{DD} = -30\text{ Vdc}$ , $I_D = -12\text{ A}$ ,<br>$V_{GS} = -10\text{ V}$ , $R_G = 9.1\ \Omega$ ) | $t_{d(on)}$  | - | 10  | 20 | ns |
| Rise Time           |  | $t_r$        | - | 45  | 85 |    |
| Turn-Off Delay Time |  | $t_{d(off)}$ | - | 26  | 40 |    |
| Fall Time           |  | $t_f$        | - | 48  | 90 |    |
| Gate Charge         | $(V_{DS} = -48\text{ Vdc}$ , $V_{GS} = -10\text{ Vdc}$ ,<br>$I_D = -12\text{ A}$ )                     | $Q_T$        | - | 15  | 30 | nC |
|                     |  | $Q_{GS}$     | - | 4.0 | -  |    |
|                     |  | $Q_{GD}$     | - | 7.0 | -  |    |

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

|  |          |        |              |           |               |
|--|----------|--------|--------------|-----------|---------------|
| Diode Forward On-Voltage<br>( $I_S = 12\text{ Adc}$ , $V_{GS} = 0\text{ V}$ )<br>( $I_S = 12\text{ Adc}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150^\circ\text{C}$ ) | $V_{SD}$ | -<br>- | -1.6<br>-1.3 | -2.5<br>- | Vdc           |
| Reverse Recovery Time<br>( $I_S = 12\text{ A}$ , $di_S/dt = 100\text{ A}/\mu\text{s}$ , $V_{GS} = 0\text{ V}$ )  | $t_{rr}$ | -      | 50           |           | ns            |
|  | $t_a$    | -      | 40           | -         |               |
|  | $t_b$    | -      | 10           | -         |               |
| Reverse Recovery Stored Charge   | $Q_{RR}$ | -      | 0.10         | -         | $\mu\text{C}$ |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

3. Indicates Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

4. Switching characteristics are independent of operating junction temperature.

# NTD2955, NVD2955

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

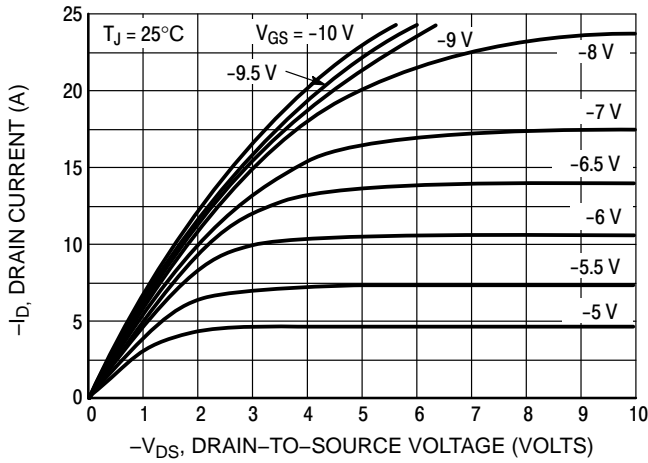


Figure 1. On-Region Characteristics

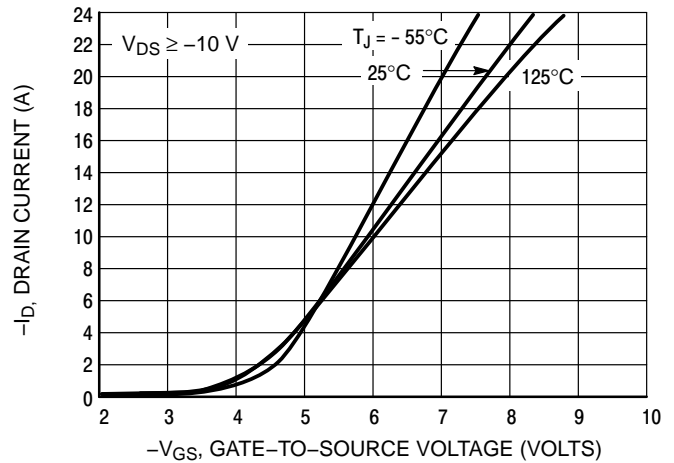


Figure 2. Transfer Characteristics

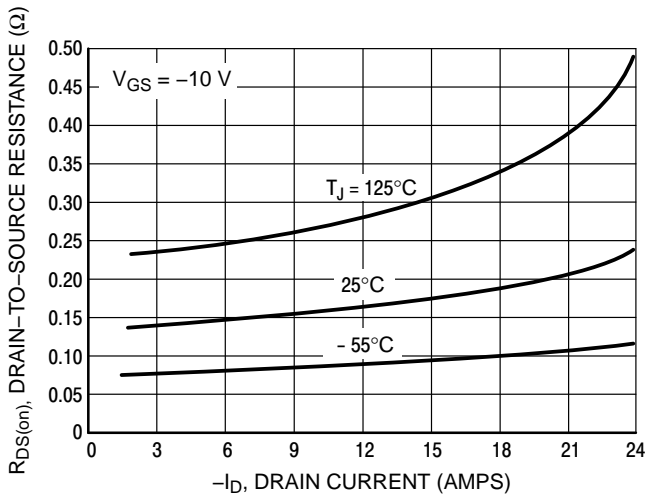


Figure 3. On-Resistance versus Drain Current and Temperature

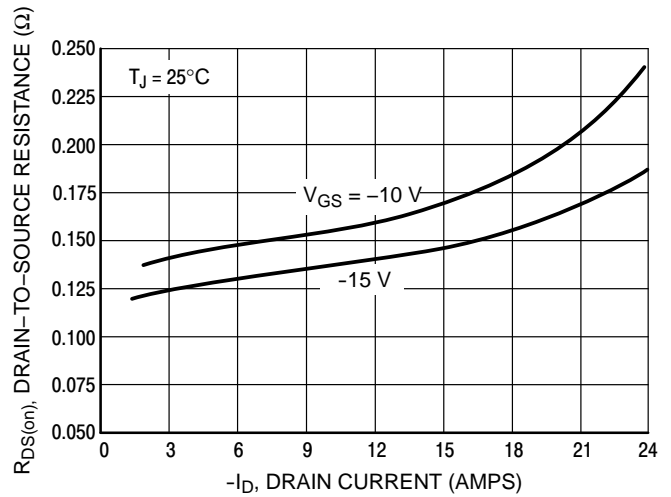


Figure 4. On-Resistance versus Drain Current and Gate Voltage

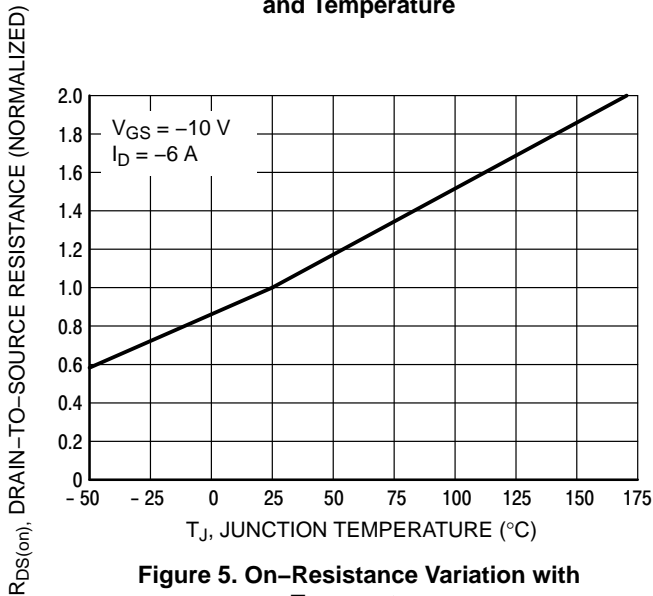


Figure 5. On-Resistance Variation with Temperature

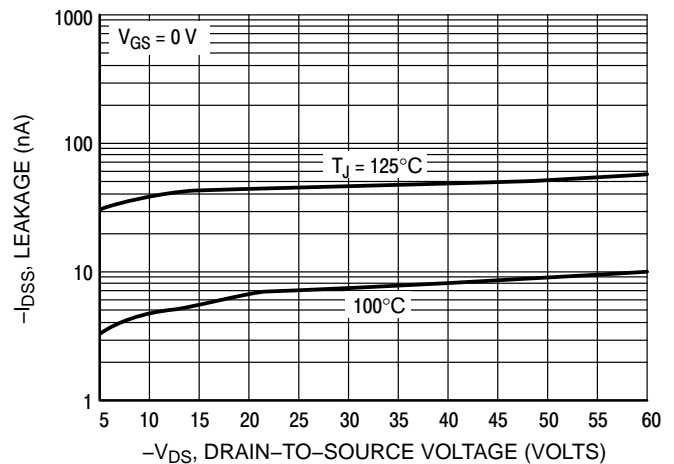
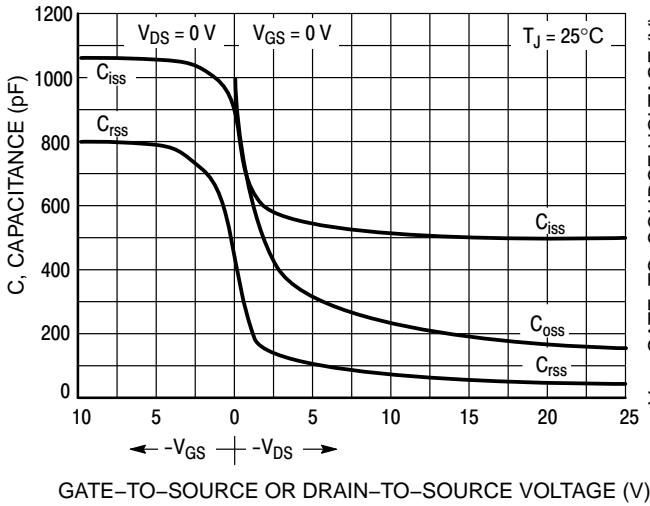
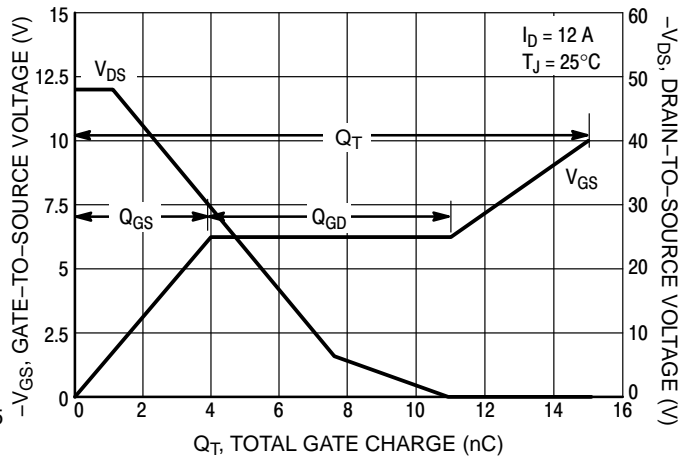


Figure 6. Drain-To-Source Leakage Current versus Voltage

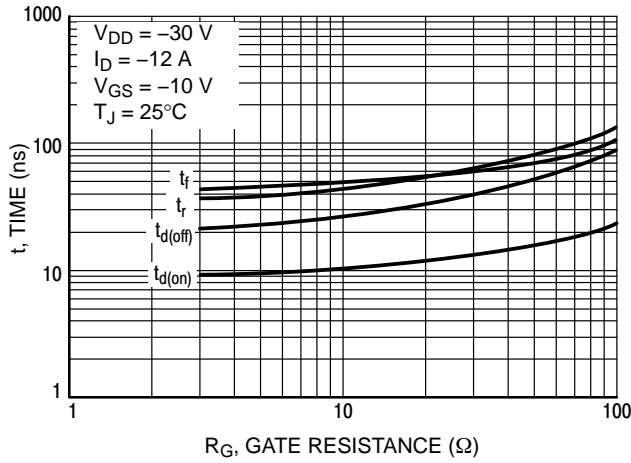
# NTD2955, NVD2955



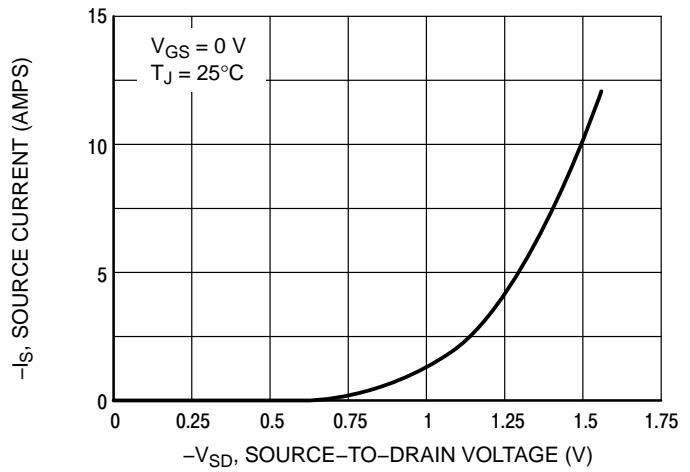
**Figure 7. Capacitance Variation**



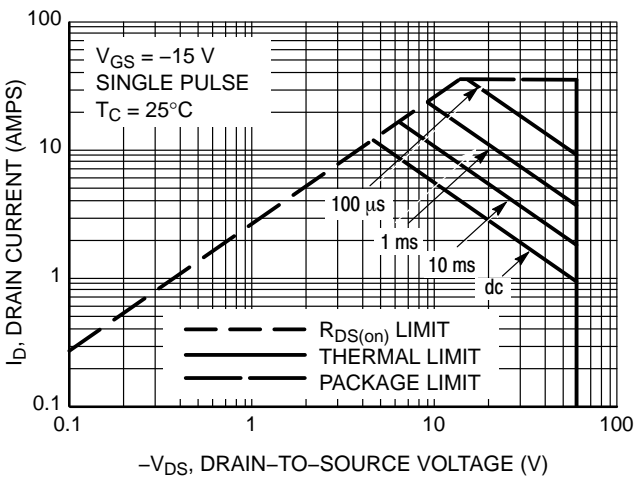
**Figure 8. Gate-To-Source and Drain-To-Source Voltage versus Total Charge**



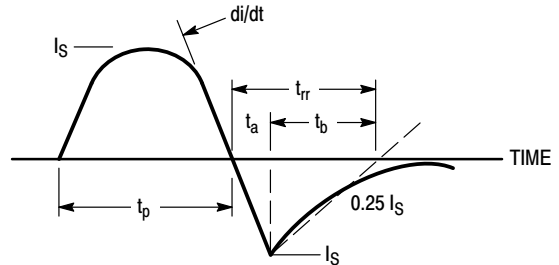
**Figure 9. Resistive Switching Time Variation versus Gate Resistance**



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

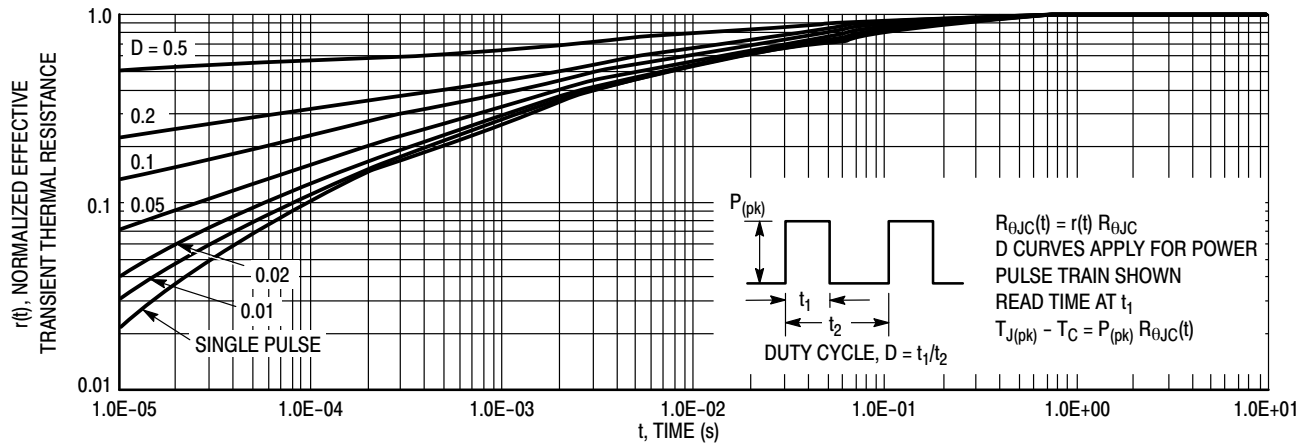


**Figure 11. Maximum Rated Forward Biased Safe Operating Area**



**Figure 12. Diode Reverse Recovery Waveform**

## NTD2955, NVD2955



**Figure 13. Thermal Response**

### ORDERING INFORMATION

| Device      | Package           | Shipping <sup>†</sup> |
|-------------|-------------------|-----------------------|
| 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    |
| NVD2955T4G* | DPAK<br>(Pb-Free) | 2500 / Tape & Reel    |

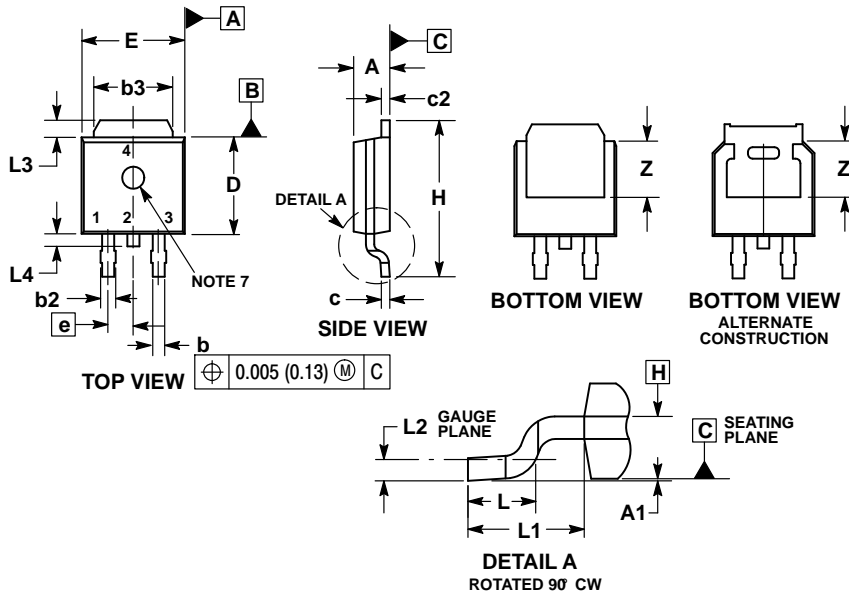
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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

# NTD2955, NVD2955

## PACKAGE DIMENSIONS

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



**NOTES:**

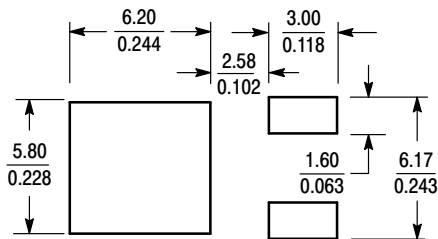
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES PER SIDE.
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.
7. OPTIONAL MOLD FEATURE.

| 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  | 0.028     | 0.045 | 0.72        | 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  | 0.114 REF |       | 2.90 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\*



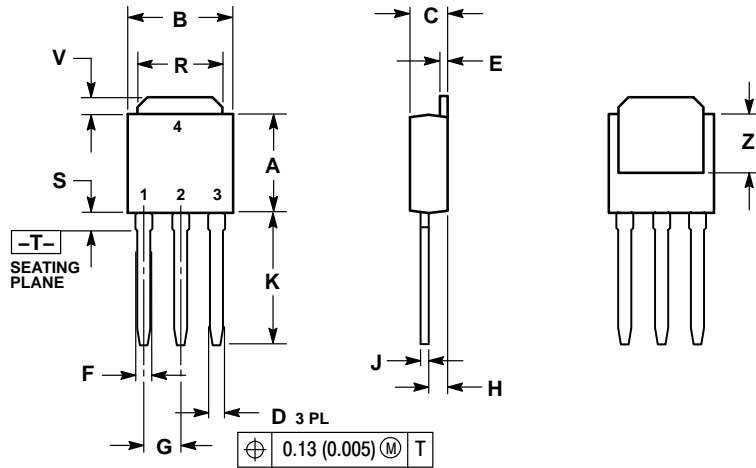
SCALE 3:1 (mm/inches)

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

# NTD2955, 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

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