

# NTD4302

## Power MOSFET

68 A, 30 V, N-Channel DPAK/IPAK

### Features

- Ultra Low  $R_{DS(on)}$
- Higher Efficiency Extending Battery Life
- Logic Level Gate Drive
- Diode Exhibits High Speed, Soft Recovery
- Avalanche Energy Specified
- $I_{DSS}$  Specified at Elevated Temperature
- DPAK Mounting Information Provided
- These Devices are Pb-Free and are RoHS Compliant

### Applications

- DC-DC Converters
- Low Voltage Motor Control
- Power Management in Portable and Battery Powered Products:  
i.e., Computers, Printers, Cellular and Cordless Telephones,  
and PCMCIA Cards

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

| Rating                                                                                                                                                                                                                                                     | Symbol                                                 | Value                           | Unit                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------------------|----------------------------------------|
| Drain-to-Source Voltage                                                                                                                                                                                                                                    | $V_{DSS}$                                              | 30                              | Vdc                                    |
| Gate-to-Source Voltage – Continuous                                                                                                                                                                                                                        | $V_{GS}$                                               | $\pm 20$                        | Vdc                                    |
| Thermal Resistance – Junction-to-Case<br>Total Power Dissipation @ $T_C = 25^\circ\text{C}$<br>Continuous Drain Current @ $T_C = 25^\circ\text{C}$ (Note 4)<br>Continuous Drain Current @ $T_C = 100^\circ\text{C}$                                        | $R_{\theta JC}$<br>$P_D$<br>$I_D$<br>$I_D$             | 1.65<br>75<br>68<br>43          | $^\circ\text{C/W}$<br>W<br>A<br>A      |
| Thermal Resistance – Junction-to-Ambient<br>(Note 2)<br>Total Power Dissipation @ $T_A = 25^\circ\text{C}$<br>Continuous Drain Current @ $T_A = 25^\circ\text{C}$<br>Continuous Drain Current @ $T_A = 100^\circ\text{C}$<br>Pulsed Drain Current (Note 3) | $R_{\theta JA}$<br>$P_D$<br>$I_D$<br>$I_D$<br>$I_{DM}$ | 67<br>1.87<br>11.3<br>7.1<br>36 | $^\circ\text{C/W}$<br>W<br>A<br>A<br>A |
| Thermal Resistance – Junction-to-Ambient<br>(Note 1)<br>Total Power Dissipation @ $T_A = 25^\circ\text{C}$<br>Continuous Drain Current @ $T_A = 25^\circ\text{C}$<br>Continuous Drain Current @ $T_A = 100^\circ\text{C}$<br>Pulsed Drain Current (Note 3) | $R_{\theta JA}$<br>$P_D$<br>$I_D$<br>$I_D$<br>$I_{DM}$ | 120<br>1.04<br>8.4<br>5.3<br>28 | $^\circ\text{C/W}$<br>W<br>A<br>A<br>A |
| Operating and Storage Temperature Range                                                                                                                                                                                                                    | $T_J, T_{stg}$                                         | -55 to 150                      | $^\circ\text{C}$                       |
| Single Pulse Drain-to-Source Avalanche<br>Energy – Starting $T_J = 25^\circ\text{C}$<br>( $V_{DD} = 30\text{ Vdc}$ , $V_{GS} = 10\text{ Vdc}$ ,<br>Peak $I_L = 17\text{ Apk}$ , $L = 5.0\text{ mH}$ , $R_G = 25\ \Omega$ )                                 | $E_{AS}$                                               | 722                             | mJ                                     |
| Maximum Lead Temperature for Soldering<br>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.

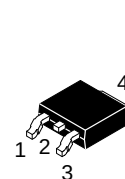
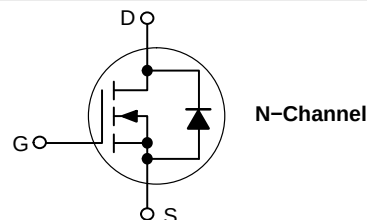
1. When surface mounted to an FR4 board using the minimum recommended pad size.
2. When surface mounted to an FR4 board using 0.5 sq. in. drain pad size.
3. Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle = 2%.
4. Current Limited by Internal Lead Wires.



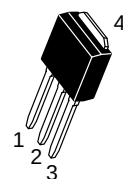
ON Semiconductor®

<http://onsemi.com>

| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP      | $I_D$ MAX |
|---------------|-----------------------|-----------|
| 30 V          | 7.8 m $\Omega$ @ 10 V | 68 A      |

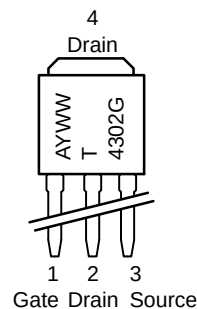
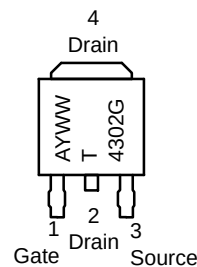


**DPAK**  
**CASE 369C**  
(Surface Mount)  
**STYLE 2**



**IPAK**  
**CASE 369D**  
(Straight Lead)  
**STYLE 2**

### MARKING DIAGRAMS & PIN ASSIGNMENTS



A = Assembly Location\*  
Y = Year  
WW = Work Week  
T4302 = Device Code  
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 in the package dimensions section on page 5 of this data sheet.

# NTD4302

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

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

### OFF CHARACTERISTICS

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

### ON CHARACTERISTICS

|                                                                                                                                                                                                                   |              |             |                           |                         |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|---------------------------|-------------------------|----------|
| Gate Threshold Voltage<br>( $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{Adc}$ )<br>Negative Temperature Coefficient                                                                                            | $V_{GS(th)}$ | 1.0<br>–    | 1.9<br>–3.8               | 3.0<br>–                | Vdc      |
| Static Drain-Source On-State Resistance<br>( $V_{GS} = 10\text{ Vdc}$ , $I_D = 20\text{ Adc}$ )<br>( $V_{GS} = 10\text{ Vdc}$ , $I_D = 10\text{ Adc}$ )<br>( $V_{GS} = 4.5\text{ Vdc}$ , $I_D = 5.0\text{ Adc}$ ) | $R_{DS(on)}$ | –<br>–<br>– | 0.0078<br>0.0078<br>0.010 | 0.010<br>0.010<br>0.013 | $\Omega$ |
| Forward Transconductance ( $V_{DS} = 15\text{ Vdc}$ , $I_D = 10\text{ Adc}$ )                                                                                                                                     | gFS          | –           | 20                        | –                       | Mhos     |

### DYNAMIC CHARACTERISTICS

|                              |                                                                                 |           |   |      |      |    |
|------------------------------|---------------------------------------------------------------------------------|-----------|---|------|------|----|
| Input Capacitance            | $(V_{DS} = 24\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ ,<br>$f = 1.0\text{ MHz}$ ) | $C_{iss}$ | – | 2050 | 2400 | pF |
| Output Capacitance           |                                                                                 | $C_{oss}$ | – | 640  | 800  |    |
| Reverse Transfer Capacitance |                                                                                 | $C_{rss}$ | – | 225  | 310  |    |

### SWITCHING CHARACTERISTICS (Note 6)

|                     |                                                                                                                   |               |   |     |     |    |
|---------------------|-------------------------------------------------------------------------------------------------------------------|---------------|---|-----|-----|----|
| Turn-On Delay Time  | $(V_{DD} = 25\text{ Vdc}$ , $I_D = 1.0\text{ Adc}$ ,<br>$V_{GS} = 10\text{ Vdc}$ ,<br>$R_G = 6.0\text{ }\Omega$ ) | $t_{d(on)}$   | – | 11  | 20  | ns |
| Rise Time           |                                                                                                                   | $t_r$         | – | 15  | 25  |    |
| Turn-Off Delay Time |                                                                                                                   | $t_{d(off)}$  | – | 85  | 130 |    |
| Fall Time           |                                                                                                                   | $t_f$         | – | 55  | 90  |    |
| Turn-On Delay Time  | $(V_{DD} = 25\text{ Vdc}$ , $I_D = 1.0\text{ Adc}$ ,<br>$V_{GS} = 10\text{ Vdc}$ ,<br>$R_G = 2.5\text{ }\Omega$ ) | $t_{d(on)}$   | – | 11  | 20  | ns |
| Rise Time           |                                                                                                                   | $t_r$         | – | 13  | 20  |    |
| Turn-Off Delay Time |                                                                                                                   | $t_{d(off)}$  | – | 55  | 90  |    |
| Fall Time           |                                                                                                                   | $t_f$         | – | 40  | 75  |    |
| Turn-On Delay Time  | $(V_{DD} = 24\text{ Vdc}$ , $I_D = 20\text{ Adc}$ ,<br>$V_{GS} = 10\text{ Vdc}$ ,<br>$R_G = 2.5\text{ }\Omega$ )  | $t_{d(on)}$   | – | 15  | –   | ns |
| Rise Time           |                                                                                                                   | $t_r$         | – | 25  | –   |    |
| Turn-Off Delay Time |                                                                                                                   | $t_{d(off)}$  | – | 40  | –   |    |
| Fall Time           |                                                                                                                   | $t_f$         | – | 58  | –   |    |
| Gate Charge         | $(V_{DS} = 24\text{ Vdc}$ , $I_D = 2.0\text{ Adc}$ ,<br>$V_{GS} = 10\text{ Vdc}$ )                                | $Q_T$         | – | 55  | 80  | nC |
|                     |                                                                                                                   | $Q_{gs} (Q1)$ | – | 5.5 | –   |    |
|                     |                                                                                                                   | $Q_{gd} (Q2)$ | – | 15  | –   |    |

### BODY-DRAIN DIODE RATINGS (Note 5)

|                                                                                                                                                                                                                      |                                                                                        |                 |   |       |     |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------|---|-------|-----|-----|
| Diode Forward On-Voltage<br>(I <sub>S</sub> = 2.3 Adc, V <sub>GS</sub> = 0 Vdc)<br>(I <sub>S</sub> = 20 Adc, V <sub>GS</sub> = 0 Vdc)<br>(I <sub>S</sub> = 2.3 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C) |                                                                                        | V <sub>SD</sub> | – | 0.75  | 1.0 | Vdc |
|                                                                                                                                                                                                                      |                                                                                        |                 | – | 0.90  | –   |     |
|                                                                                                                                                                                                                      |                                                                                        |                 | – | 0.65  | –   |     |
| Reverse Recovery Time                                                                                                                                                                                                | (I <sub>S</sub> = 2.3 Adc, V <sub>GS</sub> = 0 Vdc,<br>dI <sub>S</sub> /dt = 100 A/μs) | t <sub>rr</sub> | – | 39    | 65  | ns  |
|                                                                                                                                                                                                                      |                                                                                        | t <sub>a</sub>  | – | 20    | –   |     |
|                                                                                                                                                                                                                      |                                                                                        | t <sub>b</sub>  | – | 19    | –   |     |
| Reverse Recovery Stored Charge                                                                                                                                                                                       |                                                                                        | Q <sub>rr</sub> | – | 0.043 | –   | μC  |

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.

5. Indicates Pulse Test: Pulse Width = 300  $\mu\text{sec}$  max, Duty Cycle  $\leq 2\%$ .

6. Switching characteristics are independent of operating junction temperature.

TYPICAL CHARACTERISTICS

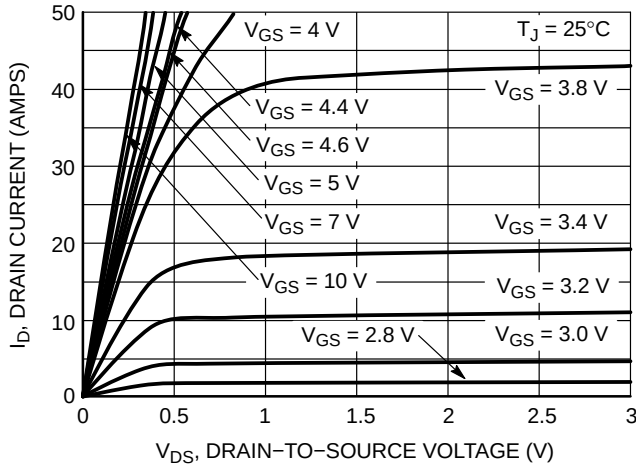


Figure 1. On-Region Characteristics

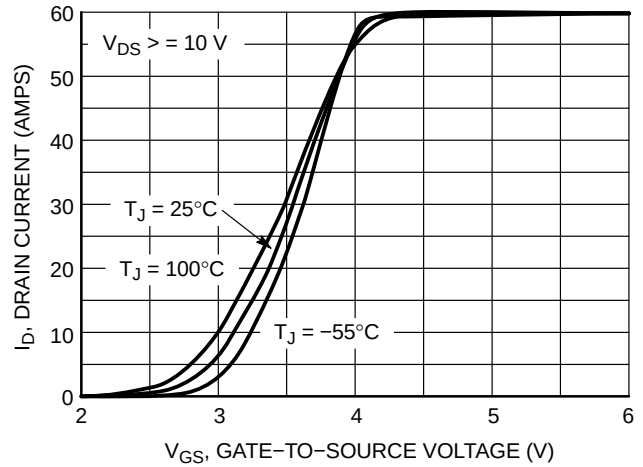


Figure 2. Transfer Characteristics

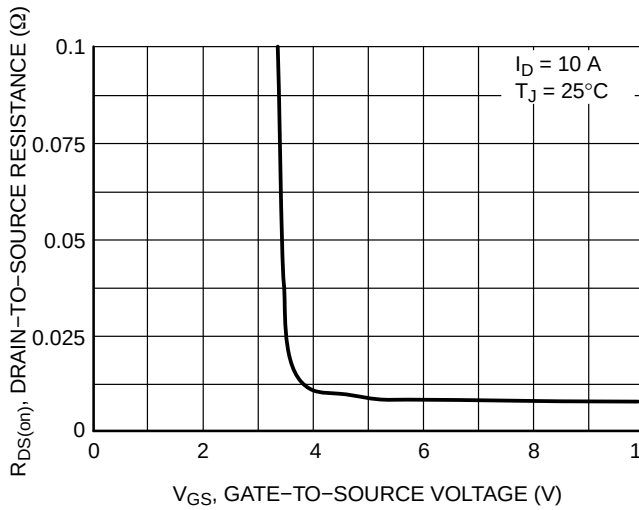


Figure 3. On-Resistance vs. Gate-to-Source Voltage

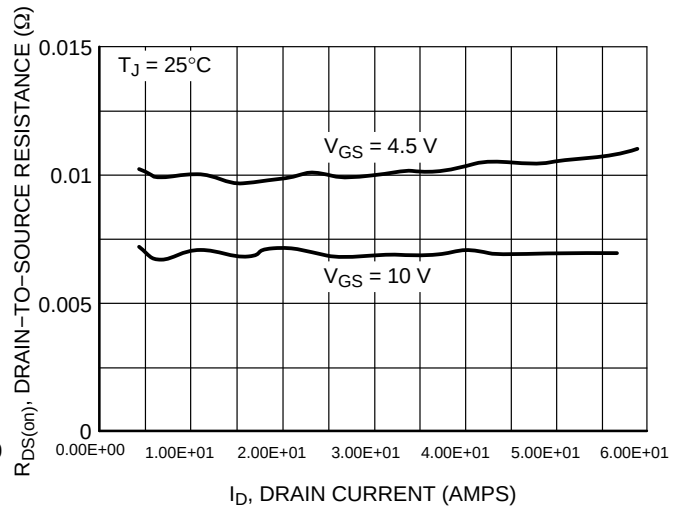


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

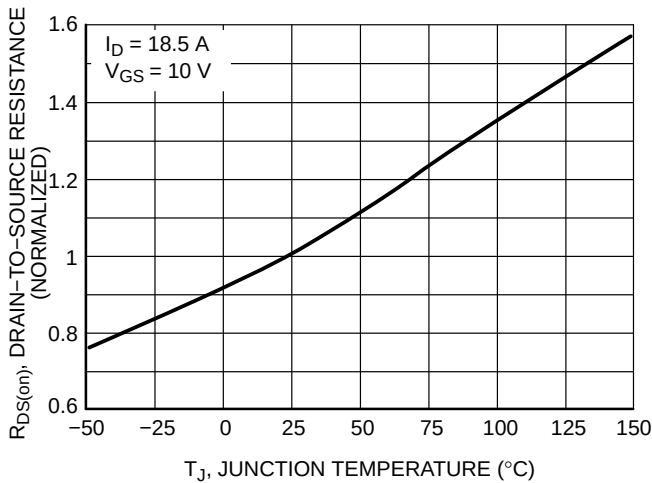


Figure 5. On-Resistance Variation with Temperature

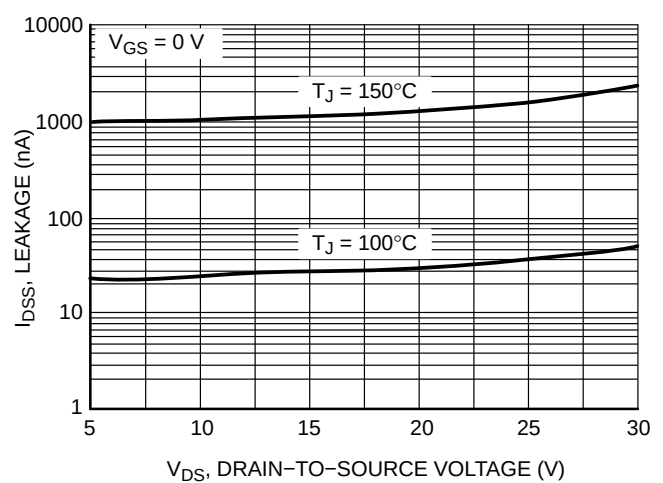


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

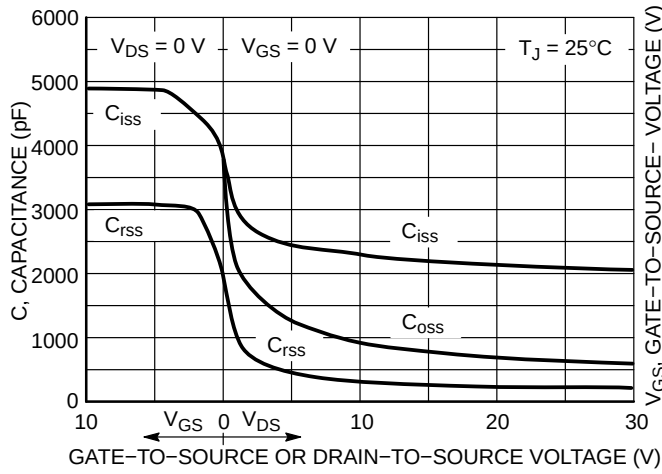


Figure 7. Capacitance Variation

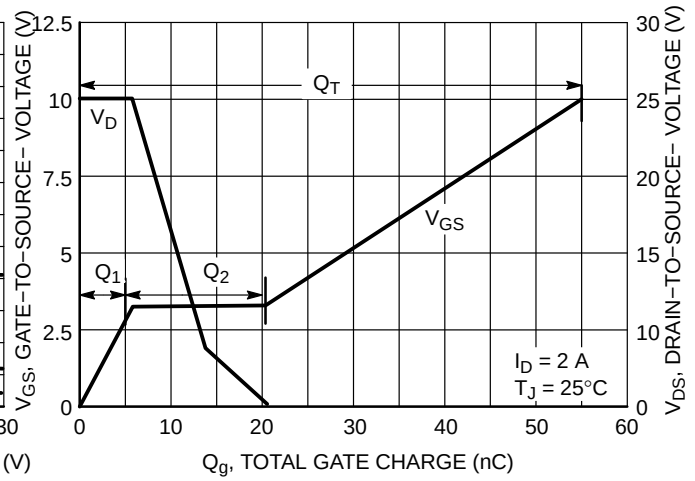


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

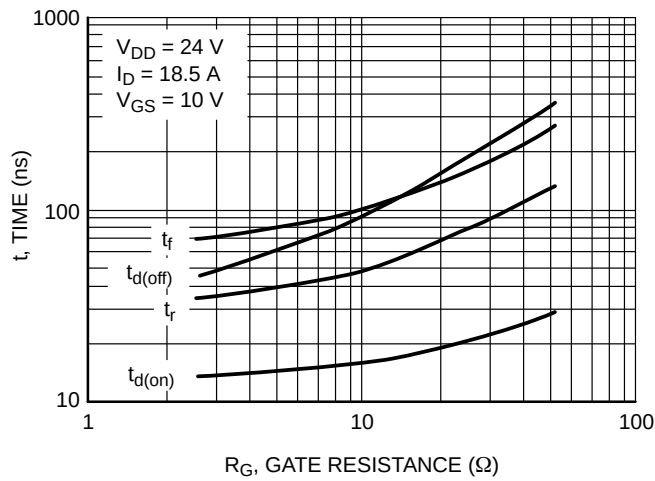


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

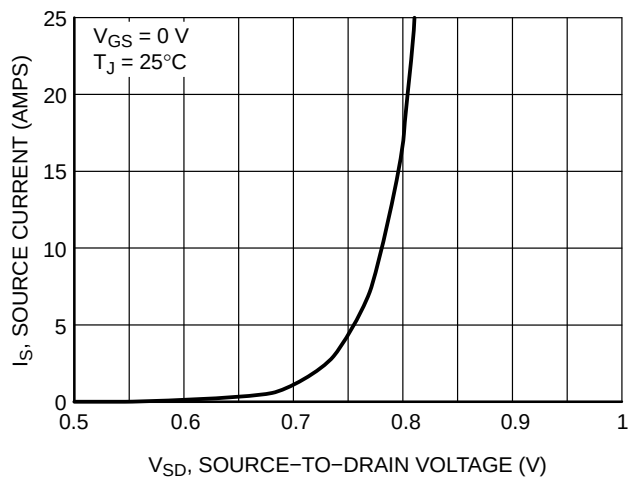


Figure 10. Diode Forward Voltage vs. Current

# NTD4302

## TYPICAL CHARACTERISTICS

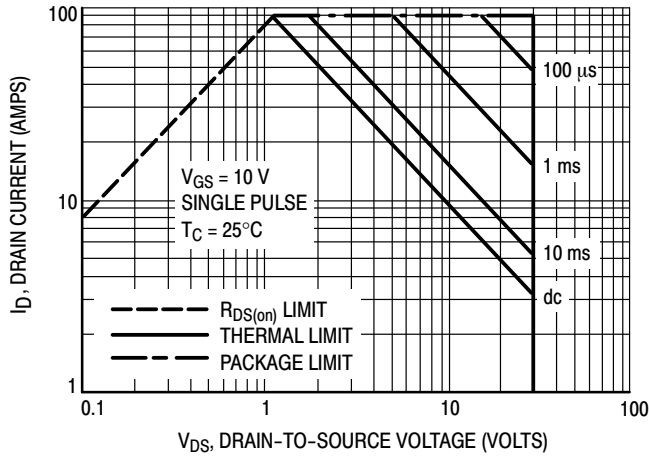


Figure 11. Maximum Rated Forward Biased Safe Operating Area

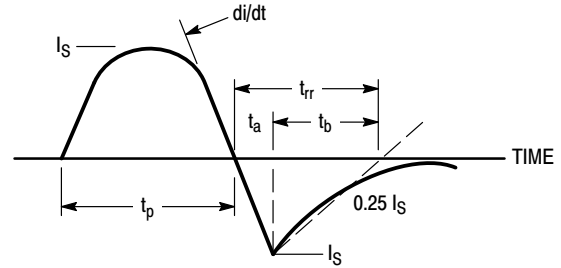


Figure 12. Diode Reverse Recovery Waveform

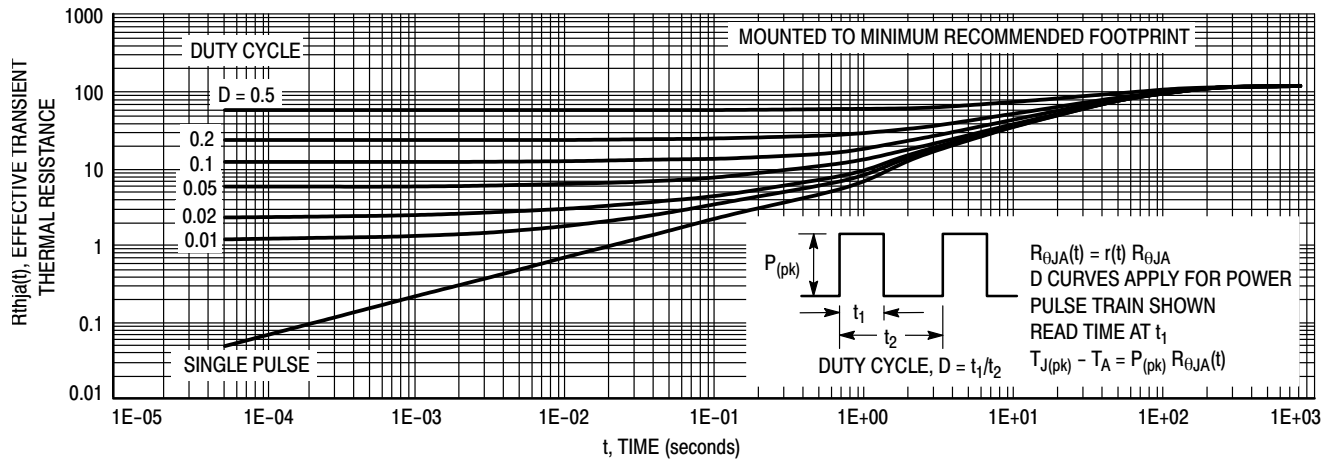


Figure 13. Thermal Response – Various Duty Cycles

## ORDERING INFORMATION

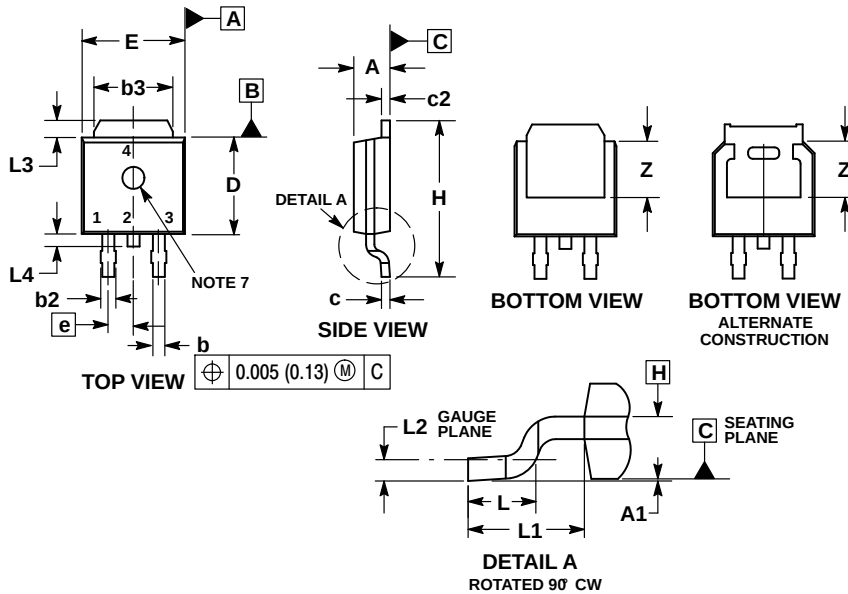
| Device     | Package Type | Package           | Shipping <sup>†</sup> |
|------------|--------------|-------------------|-----------------------|
| NTD4302G   | DPAK         | 369C<br>(Pb-Free) | 75 Units / Rail       |
| NTD4302-1G | IPAK         | 369D<br>(Pb-Free) | 75 Units / Rail       |
| NTD4302T4G | DPAK         | 369C<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.

# NTD4302

## PACKAGE DIMENSIONS

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

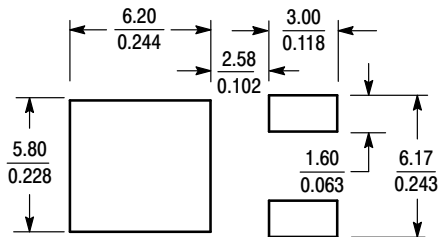


#### NOTES:

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        | ---   |

#### SOLDERING FOOTPRINT\*



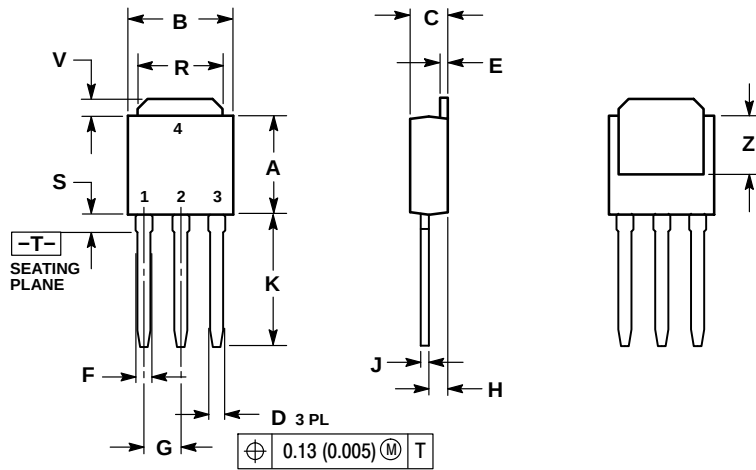
SCALE 3:1  $\left( \frac{\text{mm}}{\text{inches}} \right)$

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

# NTD4302

## 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:
1. GATE
  2. DRAIN
  3. SOURCE
  4. DRAIN

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