

# NTD23N03R

## Power MOSFET

23 A, 25 V, N-Channel DPAK

### Features

- Planar HD3e Process for Fast Switching Performance
- Low  $R_{DS(on)}$  to Minimize Conduction Loss
- Low  $C_{iss}$  to Minimize Driver Loss
- Low Gate Charge
- Optimized for High Side Switching Requirements in High-Efficiency DC-DC Converters
- Pb-Free Packages are Available

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

| Parameter                                                                      | Symbol          | Value      | Unit               |
|--------------------------------------------------------------------------------|-----------------|------------|--------------------|
| Drain-to-Source Voltage                                                        | $V_{DS}$        | 25         | Vdc                |
| Gate-to-Source Voltage – Continuous                                            | $V_{GS}$        | $\pm 20$   | Vdc                |
| Thermal Resistance, Junction-to-Case                                           | $R_{\theta JC}$ | 5.6        | $^\circ\text{C/W}$ |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$                             | $P_D$           | 22.3       | W                  |
| Drain Current                                                                  | $I_D$           | 23         | A                  |
| – Continuous @ $T_C = 25^\circ\text{C}$ , Chip                                 | $I_D$           | 17.1       | A                  |
| – Continuous @ $T_C = 25^\circ\text{C}$ , Limited by Package                   | $I_D$           |            |                    |
| – Single Pulse                                                                 | $I_{DM}$        | 40         | A                  |
| Thermal Resistance, Junction-to-Ambient (Note 1)                               | $R_{\theta JA}$ | 76         | $^\circ\text{C/W}$ |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$                             | $P_D$           | 1.64       | W                  |
| Drain Current – Continuous @ $T_A = 25^\circ\text{C}$                          | $I_D$           | 4.5        | A                  |
| Thermal Resistance, Junction-to-Ambient (Note 2)                               | $R_{\theta JA}$ | 110        | $^\circ\text{C/W}$ |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$                             | $P_D$           | 1.14       | W                  |
| Drain Current – Continuous @ $T_A = 25^\circ\text{C}$                          | $I_D$           | 3.8        | A                  |
| Operating and Storage Temperature Range                                        | $T_J, T_{stg}$  | -55 to 150 | $^\circ\text{C}$   |
| Maximum Lead Temperature for Soldering Purposes, 1/8" 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 0.5 sq in pad size.
2. When surface mounted to an FR4 board using minimum recommended pad size.

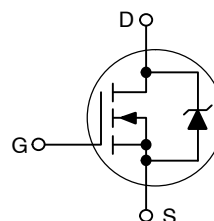


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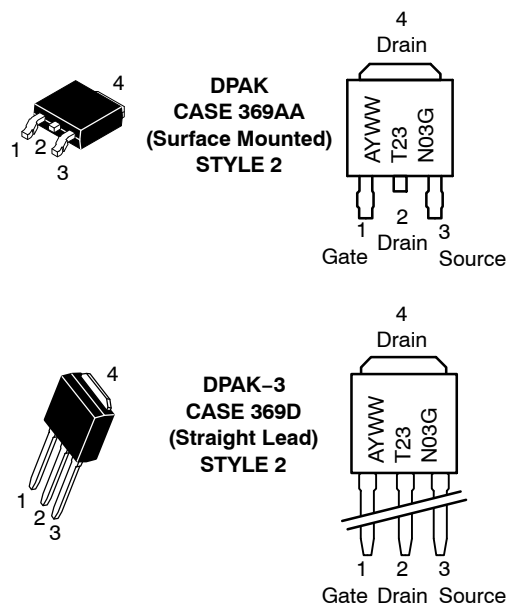
<http://onsemi.com>

| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP | $I_D$ MAX |
|---------------|------------------|-----------|
| 25 V          | 32 m $\Omega$    | 23 A      |

### N-CHANNEL



### MARKING DIAGRAMS



T23N03 = Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
G = Pb-Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

# NTD23N03R

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

| Characteristics | 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> = 250 μAdc)<br>Temperature Coefficient (Positive)                              | V <sub>(br)</sub> DSS | 25<br>– | 28<br>– | –<br>–    | Vdc<br>mV/°C |
| Zero Gate Voltage Drain Current<br>(V <sub>DS</sub> = 20 Vdc, V <sub>GS</sub> = 0 Vdc)<br>(V <sub>DS</sub> = 20 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 150°C) | I <sub>DSS</sub>      | –<br>–  | –<br>–  | 1.0<br>10 | μAdc         |
| Gate-Body Leakage Current<br>(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 (Note 3)<br>(V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μAdc)<br>Threshold Temperature Coefficient (Negative)         | V <sub>GS(th)</sub> | 1.0<br>– | 1.8<br>–     | 2.0<br>– | Vdc<br>mV/°C |
| Static Drain-to-Source On-Resistance (Note 3)<br>(V <sub>GS</sub> = 4.5 Vdc, I <sub>D</sub> = 6 Adc)<br>(V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 6 Adc) | R <sub>DS(on)</sub> | –<br>–   | 50.3<br>32.3 | 60<br>45 | mΩ           |
| Forward Transconductance (Note 3)<br>(V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 6 Adc)                                                                    | g <sub>FS</sub>     | –        | 13           | –        | Mhos         |

### DYNAMIC CHARACTERISTICS

|                      |                                                              |                  |   |     |   |    |
|----------------------|--------------------------------------------------------------|------------------|---|-----|---|----|
| Input Capacitance    | (V <sub>DS</sub> = 20 Vdc, V <sub>GS</sub> = 0 V, f = 1 MHz) | C <sub>iss</sub> | – | 225 | – | pF |
| Output Capacitance   |                                                              | C <sub>oss</sub> | – | 108 | – |    |
| Transfer Capacitance |                                                              | C <sub>rss</sub> | – | 48  | – |    |

### SWITCHING CHARACTERISTICS (Note 4)

|                     |                                                                                                       |                     |   |      |   |    |
|---------------------|-------------------------------------------------------------------------------------------------------|---------------------|---|------|---|----|
| Turn-On Delay Time  | (V <sub>GS</sub> = 10 Vdc, V <sub>DD</sub> = 10 Vdc,<br>I <sub>D</sub> = 6 Adc, R <sub>G</sub> = 3 Ω) | t <sub>d(on)</sub>  | – | 2.0  | – | ns |
| Rise Time           |                                                                                                       | t <sub>r</sub>      | – | 14.9 | – |    |
| Turn-Off Delay Time |                                                                                                       | t <sub>d(off)</sub> | – | 9.9  | – |    |
| Fall Time           |                                                                                                       | t <sub>f</sub>      | – | 2.0  | – |    |
| Gate Charge         | (V <sub>GS</sub> = 4.5 Vdc, I <sub>D</sub> = 6 Adc,<br>V <sub>DS</sub> = 10 Vdc) (Note 3)             | Q <sub>T</sub>      | – | 3.76 | – | nC |
|                     |                                                                                                       | Q <sub>1</sub>      | – | 1.7  | – |    |
|                     |                                                                                                       | Q <sub>2</sub>      | – | 1.6  | – |    |

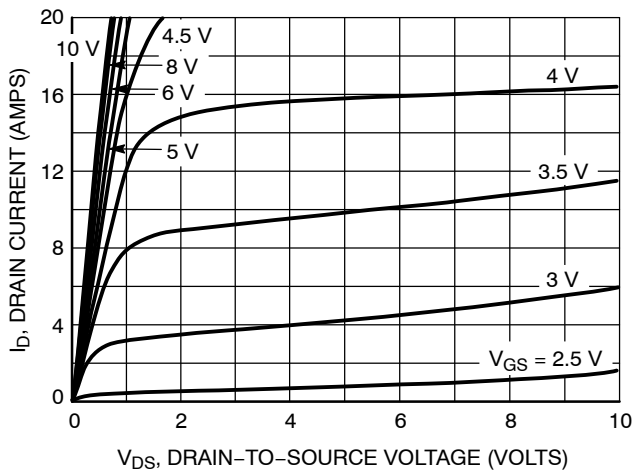
### SOURCE-DRAIN DIODE CHARACTERISTICS

|                                |                                                                                                                                         |                 |        |              |          |     |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------|--------------|----------|-----|
| Forward On-Voltage             | (I <sub>S</sub> = 6 Adc, V <sub>GS</sub> = 0 Vdc) (Note 3)<br>(I <sub>S</sub> = 6 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C) | V <sub>SD</sub> | –<br>– | 0.87<br>0.74 | 1.2<br>– | Vdc |
| Reverse Recovery Time          | (I <sub>S</sub> = 6 Adc, V <sub>GS</sub> = 0 Vdc,<br>di <sub>S</sub> /dt = 100 A/μs) (Note 3)                                           | t <sub>rr</sub> | –      | 8.7          | –        | ns  |
|                                |                                                                                                                                         | t <sub>a</sub>  | –      | 5.2          | –        |     |
|                                |                                                                                                                                         | t <sub>b</sub>  | –      | 3.5          | –        |     |
| Reverse Recovery Stored Charge |                                                                                                                                         | Q <sub>RR</sub> | –      | 0.003        | –        | μC  |

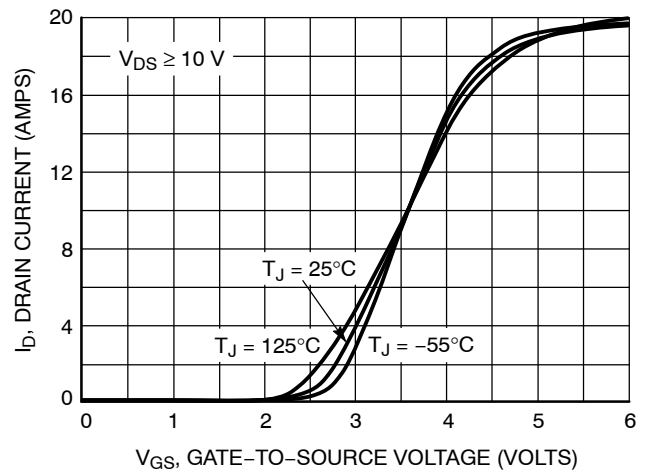
3. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

4. Switching characteristics are independent of operating junction temperatures.

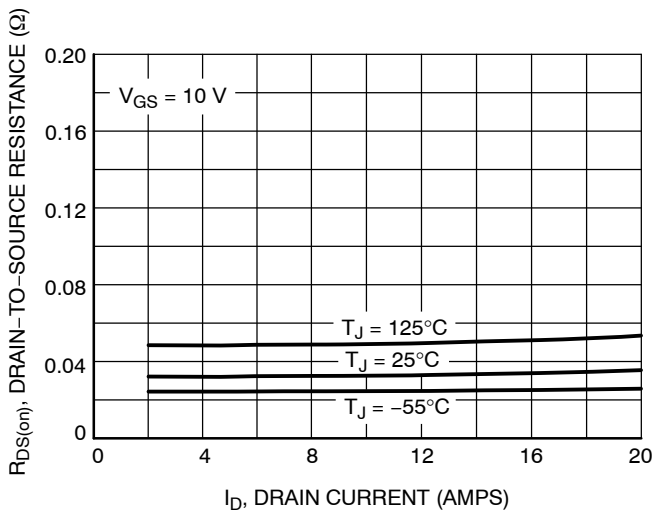
# NTD23N03R



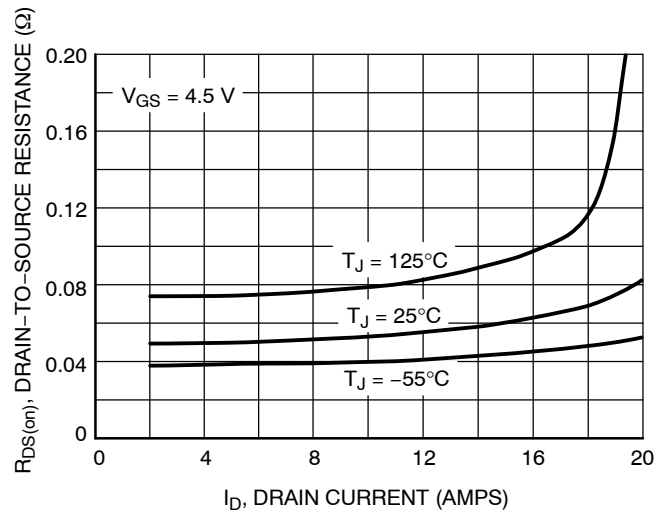
**Figure 1. On-Region Characteristics**



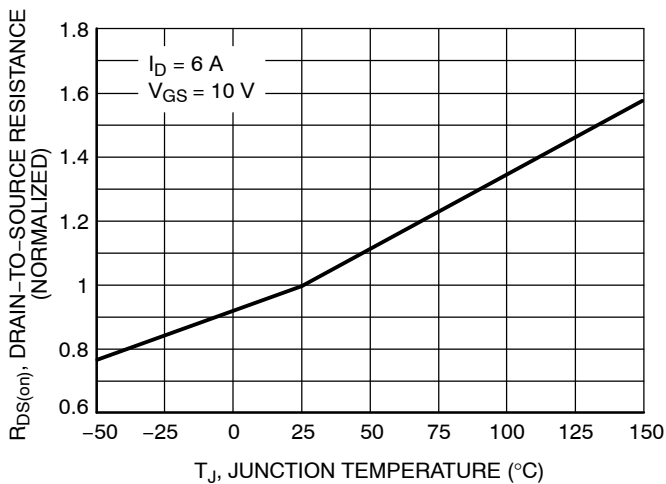
**Figure 2. Transfer Characteristics**



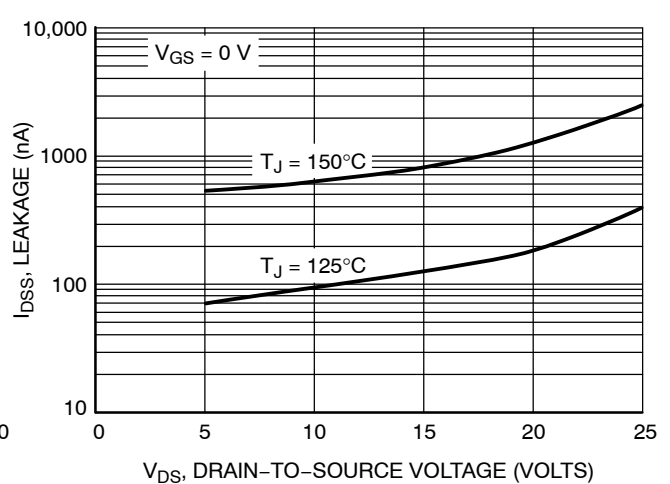
**Figure 3. On-Resistance versus Drain Current and Temperature**



**Figure 4. On-Resistance versus Drain Current and Temperature**

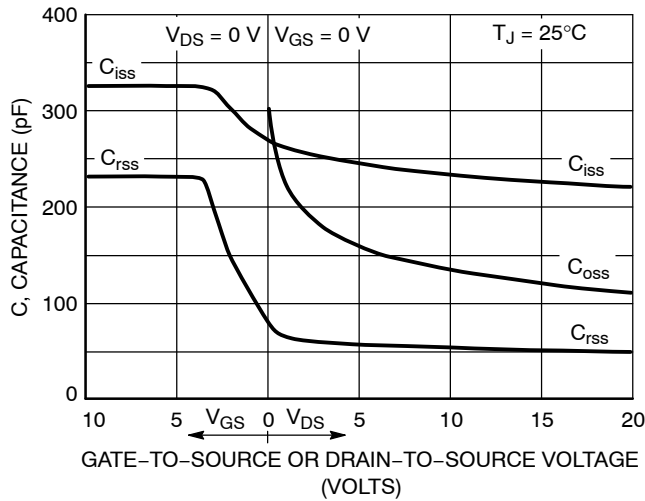


**Figure 5. On-Resistance Variation with Temperature**

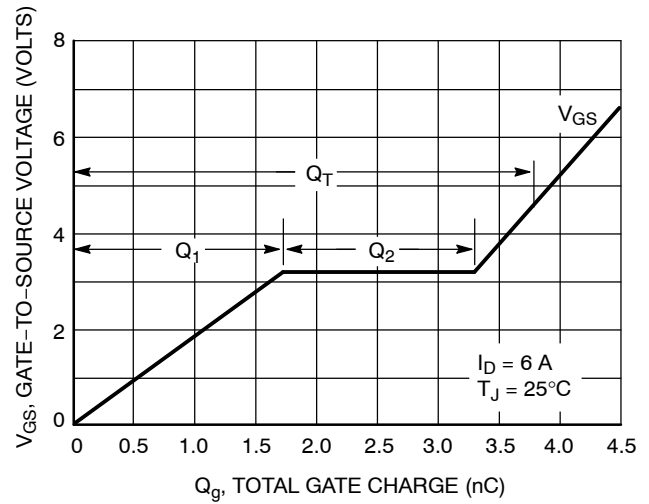


**Figure 6. Drain-to-Source Leakage Current versus Voltage**

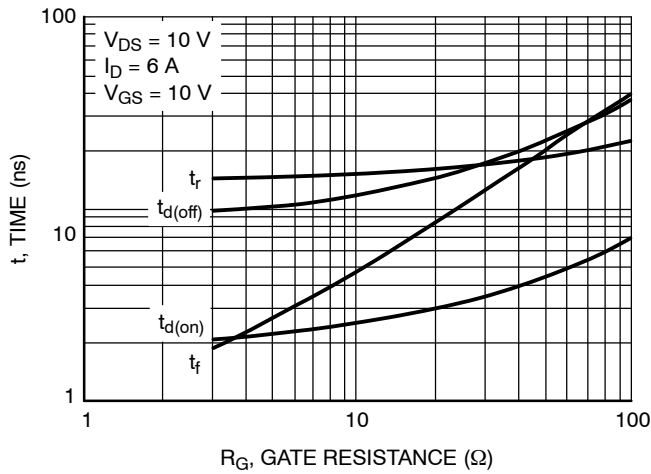
# NTD23N03R



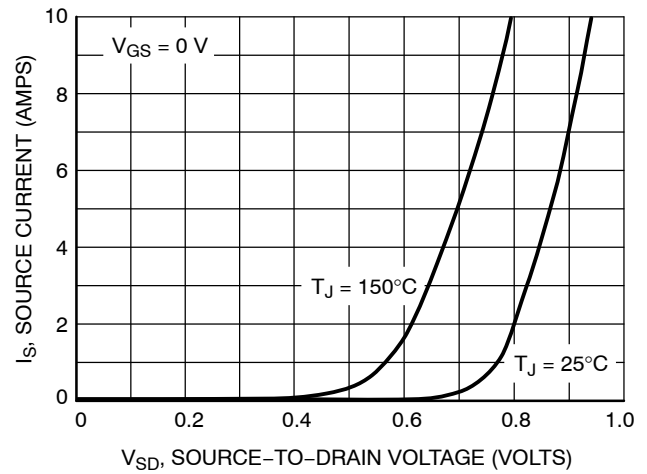
**Figure 7. Capacitance Variation**



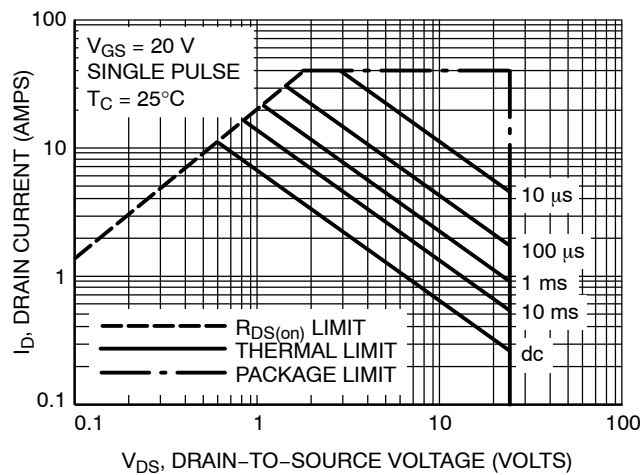
**Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge**



**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**

## NTD23N03R

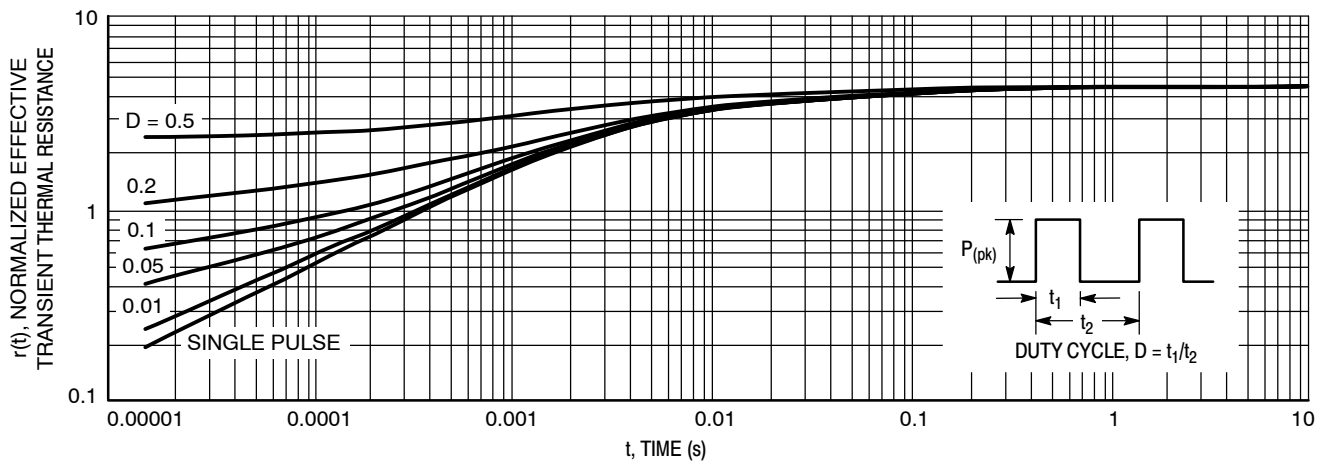


Figure 12. Thermal Response

### ORDERING INFORMATION

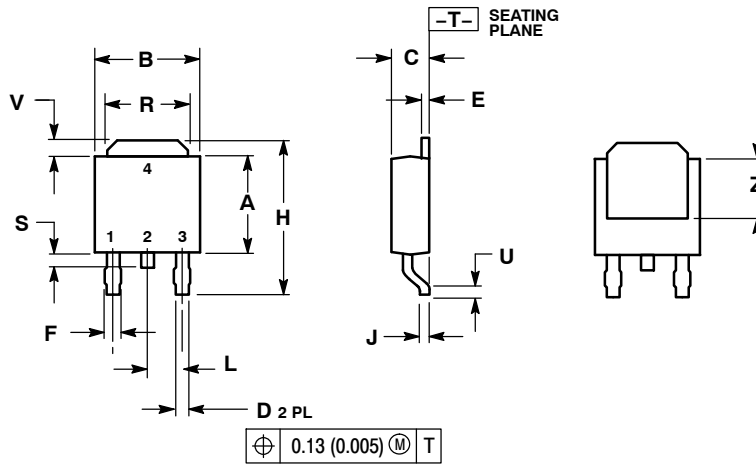
| Device       | Package             | Shipping†        |
|--------------|---------------------|------------------|
| NTD23N03RG   | DPAK<br>(Pb-Free)   | 75 Units/Rail    |
| NTD23N03R-1G | DPAK-3<br>(Pb-Free) | 75 Units/Rail    |
| NTD23N03RT4  | DPAK                | 2500 Tape & Reel |
| NTD23N03RT4G | DPAK<br>(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.

# NTD23N03R

## PACKAGE DIMENSIONS

DPAK  
CASE 369AA-01  
ISSUE O

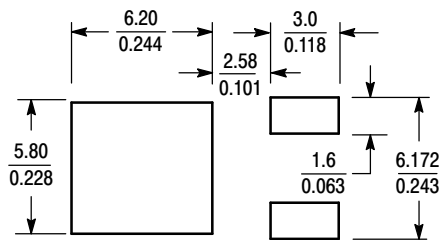


NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.

| 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\*



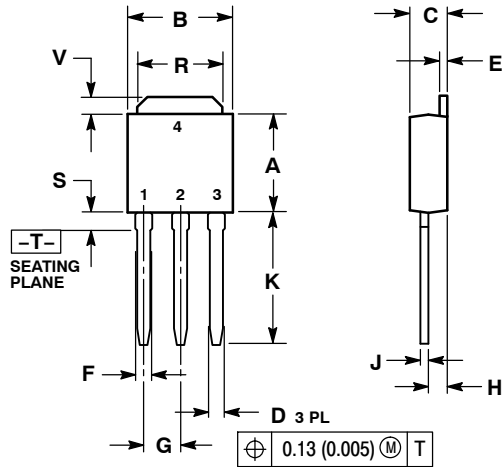
SCALE 3:1  $\left( \frac{\text{mm}}{\text{inches}} \right)$

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

# NTD23N03R

## PACKAGE DIMENSIONS

DKAK-3  
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:

- PIN 1. GATE
- DRAIN
- SOURCE
- DRAIN

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