

# NTD40N03R

## Power MOSFET

45 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
- These are Pb-Free Devices

### 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                                            | $R_{\theta JC}$ | 3.0            | $^\circ\text{C/W}$ |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$                               | $P_D$           | 50             | W                  |
| Drain Current                                                                    | $I_D$           | 45             | A                  |
| – Continuous @ $T_C = 25^\circ\text{C}$ , Chip                                   | $I_D$           | 32             | A                  |
| – Continuous @ $T_A = 25^\circ\text{C}$ , Limited by Wires                       | $I_D$           | 100            | A                  |
| – Single Pulse ( $t_p \leq 10 \mu\text{s}$ )                                     | $I_D$           |                |                    |
| Thermal Resistance – Junction-to-Ambient (Note 1)                                | $R_{\theta JA}$ | 71.4           | $^\circ\text{C/W}$ |
| – Total Power Dissipation @ $T_A = 25^\circ\text{C}$                             | $P_D$           | 2.1            | W                  |
| – Drain Current – Continuous @ $T_A = 25^\circ\text{C}$                          | $I_D$           | 9.2            | A                  |
| Thermal Resistance – Junction-to-Ambient (Note 2)                                | $R_{\theta JA}$ | 100            | $^\circ\text{C/W}$ |
| – Total Power Dissipation @ $T_A = 25^\circ\text{C}$                             | $P_D$           | 1.5            | W                  |
| – Drain Current – Continuous @ $T_A = 25^\circ\text{C}$                          | $I_D$           | 7.8            | A                  |
| Operating and Storage Temperature Range                                          | $T_J, T_{stg}$  | $-55$ to $175$ | $^\circ\text{C}$   |
| 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 0.5 sq. in pad size.
2. When surface mounted to an FR4 board using minimum recommended pad size.



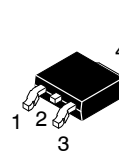
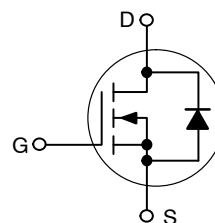
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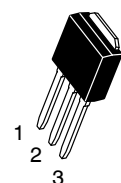
45 AMPERES, 25 VOLTS

$R_{DS(on)} = 12.6 \text{ m}\Omega$  (Typ)

### N-CHANNEL

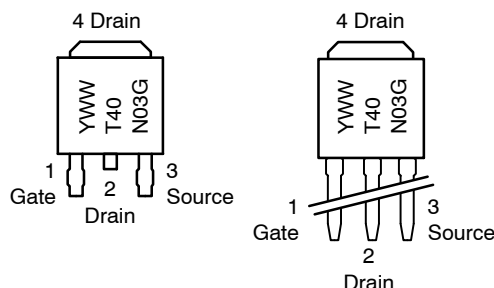


CASE 369AA  
DPAK  
(Surface Mount)  
STYLE 2



CASE 369D  
DPAK  
(Straight Lead)  
STYLE 2

### MARKING DIAGRAM & PIN ASSIGNMENTS



Y = Year  
WW = Work Week  
T40N03 = Device Code  
G = Pb-Free Package

### ORDERING INFORMATION

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

# NTD40N03R

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

| Characteristics | Symbol | Min | Typ | Max | Unit |
|-----------------|--------|-----|-----|-----|------|
|-----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                                                                                                                                                                 |               |         |         |           |                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------|---------|-----------|-----------------------------|
| Drain-to-Source Breakdown Voltage (Note 3)<br>( $V_{GS} = 0\text{ Vdc}$ , $I_D = 250\text{ }\mu\text{Adc}$ )<br>Temperature Coefficient (Positive)                              | $V_{(br)DSS}$ | 25<br>– | 28<br>– | –<br>–    | Vdc<br>mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current<br>( $V_{DS} = 20\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )<br>( $V_{DS} = 20\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ , $T_J = 150^\circ\text{C}$ ) | $I_{DSS}$     | –<br>–  | –<br>–  | 1.0<br>10 | $\mu\text{Adc}$             |
| Gate-Body Leakage Current<br>( $V_{GS} = \pm 20\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )                                                                                         | $I_{GSS}$     | –       | –       | $\pm 100$ | nAdc                        |

### ON CHARACTERISTICS (Note 3)

|                                                                                                                                                                |              |          |              |            |                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------|--------------|------------|-----------------------------|
| Gate Threshold Voltage (Note 3)<br>( $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{Adc}$ )<br>Threshold Temperature Coefficient (Negative)                    | $V_{GS(th)}$ | 1.0<br>– | 1.7<br>–     | 2.0<br>–   | Vdc<br>mV/ $^\circ\text{C}$ |
| Static Drain-to-Source On-Resistance (Note 3)<br>( $V_{GS} = 4.5\text{ Vdc}$ , $I_D = 10\text{ Adc}$ )<br>( $V_{GS} = 10\text{ Vdc}$ , $I_D = 10\text{ Adc}$ ) | $R_{DS(on)}$ | –<br>–   | 18.6<br>12.6 | 23<br>16.5 | m $\Omega$                  |
| Forward Transconductance (Note 3)<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 10\text{ Adc}$ )                                                                      | $g_{FS}$     | –        | 20           | –          | Mhos                        |

### DYNAMIC CHARACTERISTICS

|                      |                                                                          |           |   |     |   |    |
|----------------------|--------------------------------------------------------------------------|-----------|---|-----|---|----|
| Input Capacitance    | $(V_{DS} = 20\text{ Vdc}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$ ) | $C_{iss}$ | – | 584 | – | pF |
| Output Capacitance   |                                                                          | $C_{oss}$ | – | 254 | – |    |
| Transfer Capacitance |                                                                          | $C_{rss}$ | – | 99  | – |    |

### SWITCHING CHARACTERISTICS (Note 4)

|                     |                                                                                                             |              |   |      |   |    |
|---------------------|-------------------------------------------------------------------------------------------------------------|--------------|---|------|---|----|
| Turn-On Delay Time  | $(V_{GS} = 10\text{ Vdc}$ , $V_{DD} = 10\text{ Vdc}$ ,<br>$I_D = 10\text{ Adc}$ , $R_G = 3\text{ }\Omega$ ) | $t_{d(on)}$  | – | 4.5  | – | ns |
| Rise Time           |                                                                                                             | $t_r$        | – | 19.5 | – |    |
| Turn-Off Delay Time |                                                                                                             | $t_{d(off)}$ | – | 16.7 | – |    |
| Fall Time           |                                                                                                             | $t_f$        | – | 3.5  | – |    |
| Gate Charge         | $(V_{GS} = 4.5\text{ Vdc}$ , $I_D = 10\text{ Adc}$ ,<br>$V_{DS} = 10\text{ Vdc}$ ) (Note 3)                 | $Q_T$        | – | 5.78 | – | nC |
|                     |                                                                                                             | $Q_1$        | – | 2.1  | – |    |
|                     |                                                                                                             | $Q_2$        | – | 2.5  | – |    |

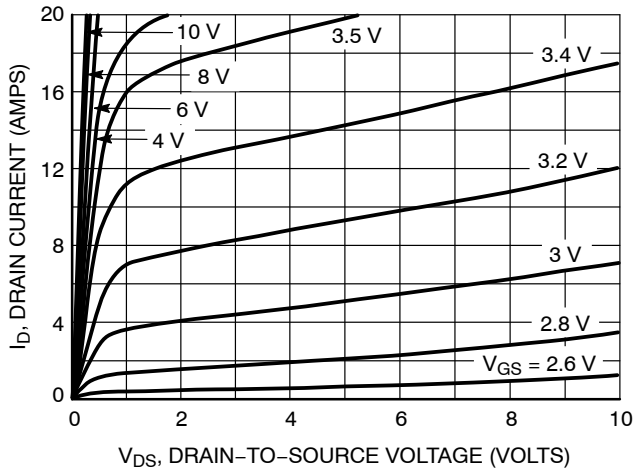
### SOURCE-DRAIN DIODE CHARACTERISTICS

|                                |                                                                                                                                               |          |        |              |          |               |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|----------|--------|--------------|----------|---------------|
| Forward On-Voltage             | $(I_S = 10\text{ Adc}$ , $V_{GS} = 0\text{ Vdc}$ ) (Note 3)<br>$(I_S = 10\text{ Adc}$ , $V_{GS} = 0\text{ Vdc}$ , $T_J = 125^\circ\text{C}$ ) | $V_{SD}$ | –<br>– | 0.85<br>0.71 | 1.2<br>– | Vdc           |
| Reverse Recovery Time          | $(I_S = 10\text{ Adc}$ , $V_{GS} = 0\text{ Vdc}$ ,<br>$di_S/dt = 100\text{ A}/\mu\text{s}$ ) (Note 3)                                         | $t_{rr}$ | –      | 20.4         | –        | ns            |
|                                |                                                                                                                                               | $t_a$    | –      | 8.25         | –        |               |
|                                |                                                                                                                                               | $t_b$    | –      | 12.1         | –        |               |
| Reverse Recovery Stored Charge |                                                                                                                                               | $Q_{RR}$ | –      | 0.007        | –        | $\mu\text{C}$ |

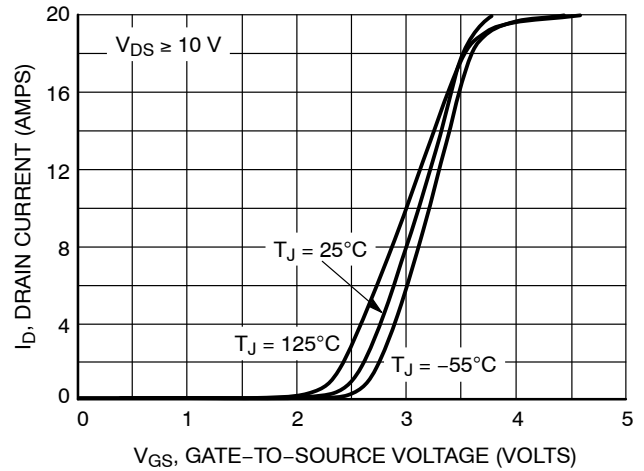
3. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

4. Switching characteristics are independent of operating junction temperatures.

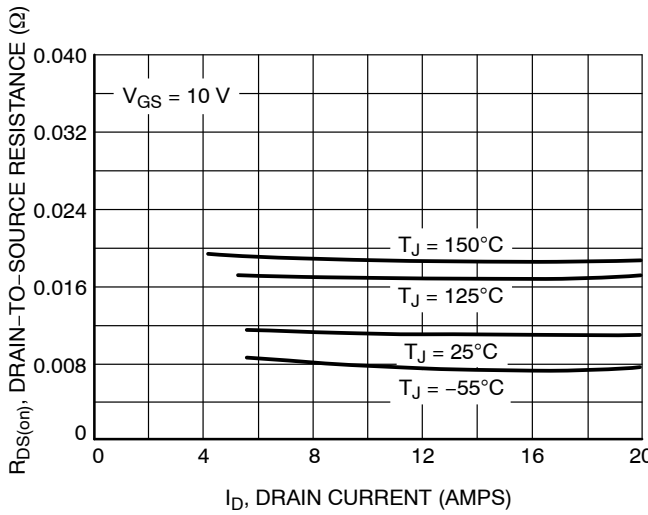
# NTD40N03R



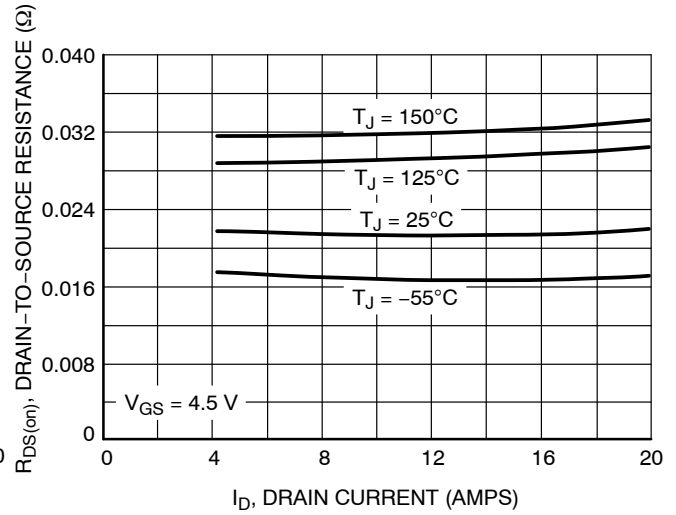
**Figure 1. On-Region Characteristics**



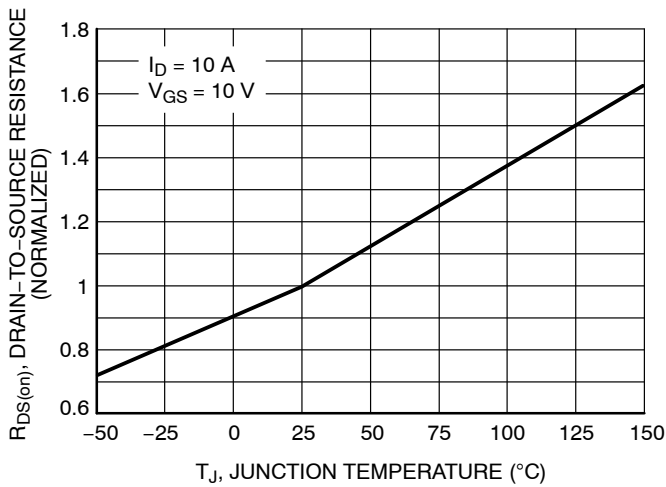
**Figure 2. Transfer Characteristics**



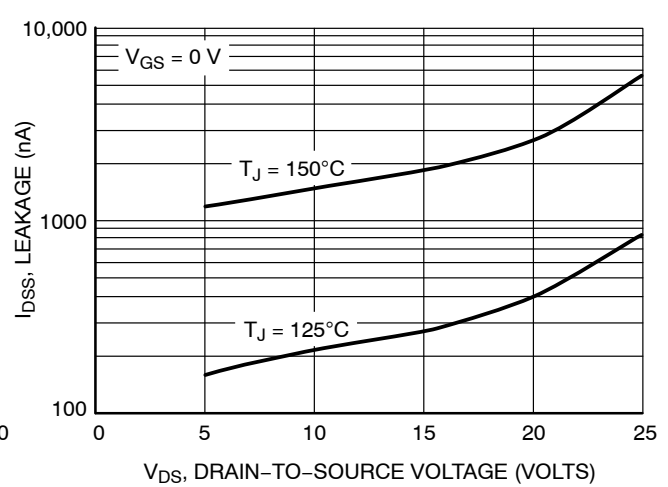
**Figure 3. On-Resistance versus Drain Current and Temperature**



**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**

# NTD40N03R

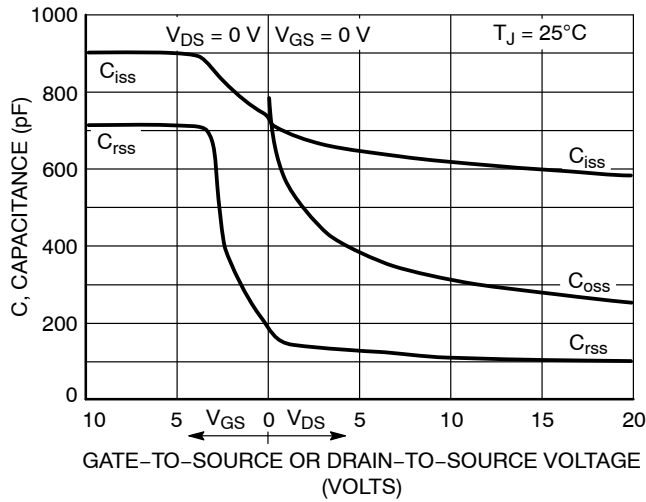


Figure 7. Capacitance Variation

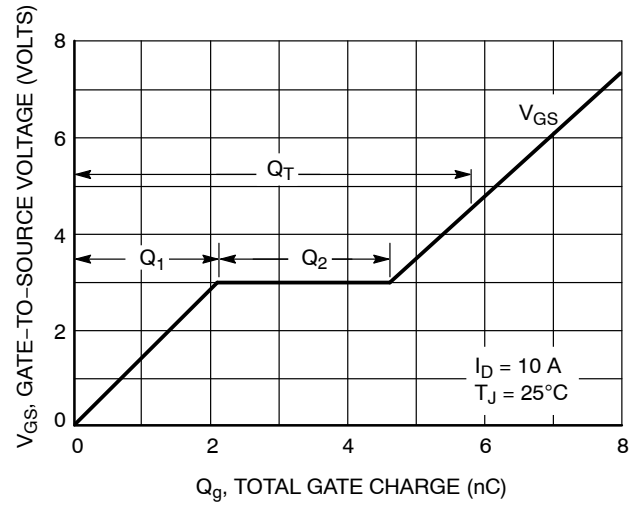


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

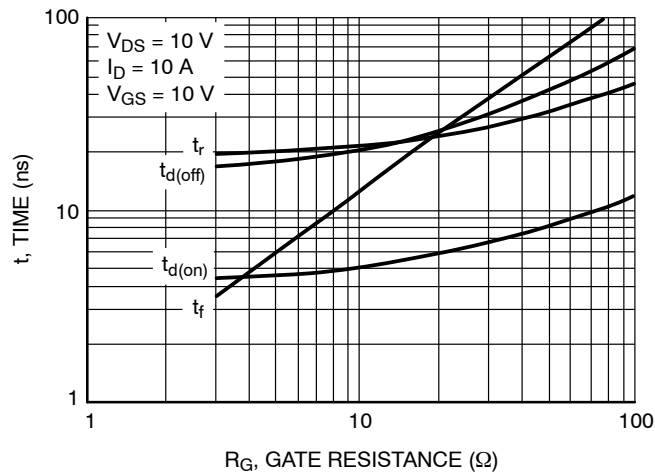


Figure 9. Resistive Switching Time Variation versus Gate Resistance

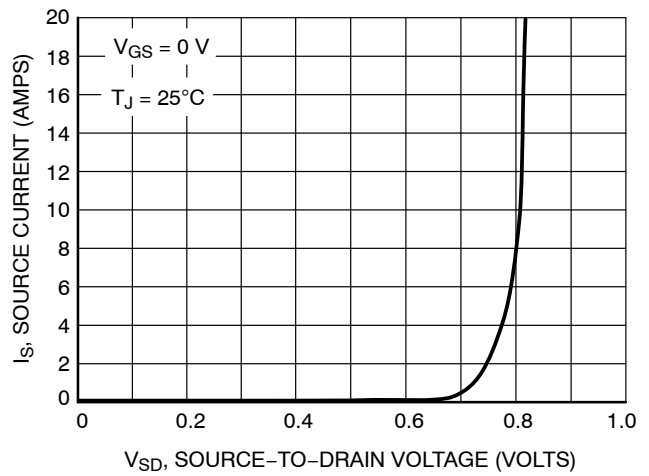


Figure 10. Diode Forward Voltage versus Current

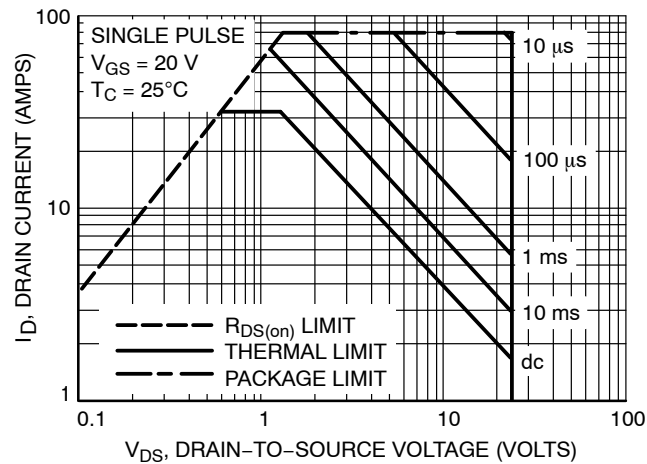


Figure 11. Maximum Rated Forward Biased Safe Operating Area

# NTD40N03R

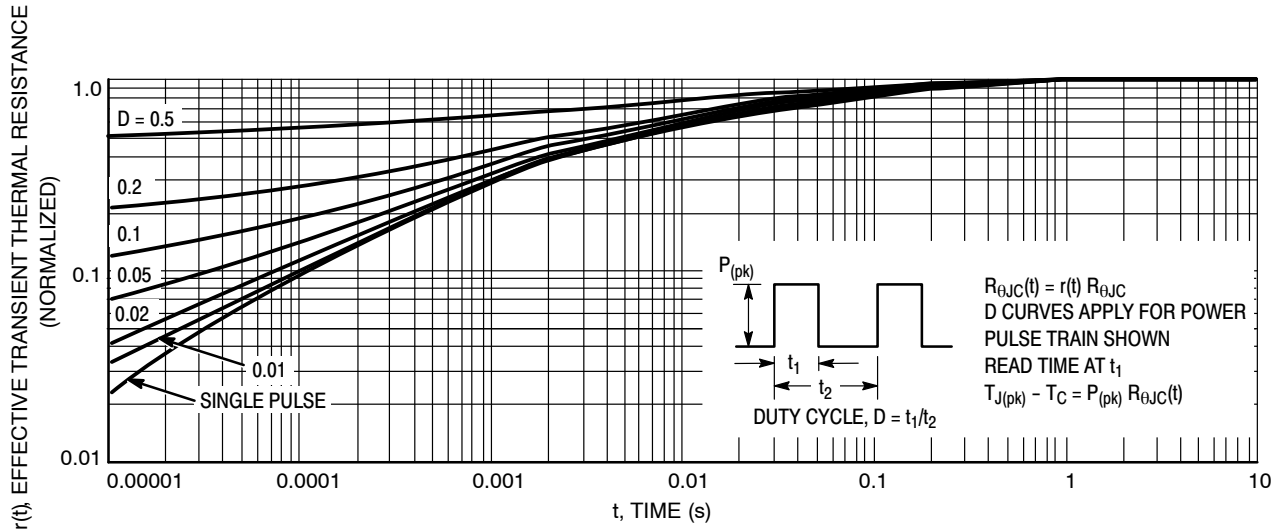
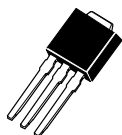


Figure 12. Thermal Response

## ORDERING INFORMATION

| Device       | Package                           | Shipping <sup>†</sup> |
|--------------|-----------------------------------|-----------------------|
| NTD40N03R-1G | DPAK (Straight Lead)<br>(Pb-Free) | 75 Units/Rail         |
| NTD40N03RT4G | DPAK<br>(Pb-Free)                 | 2500 Tape & Reel      |

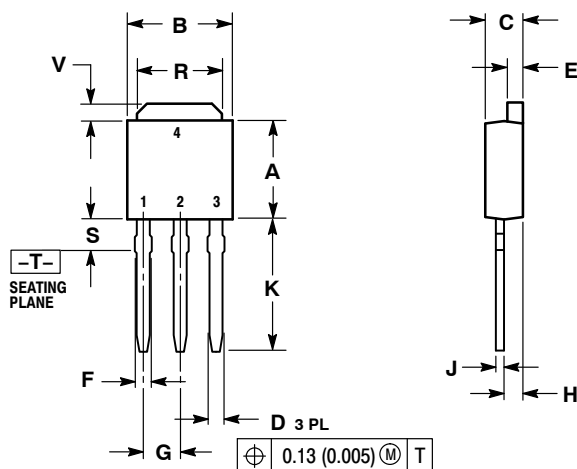
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



DPAK INSERTION MOUNT  
CASE 369  
ISSUE O

DATE 02 JAN 2000

SCALE 1:1



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

| DIM | INCHES    |       | MILLIMETERS |      |
|-----|-----------|-------|-------------|------|
|     | MIN       | MAX   | MIN         | MAX  |
| A   | 0.235     | 0.250 | 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   | 0.033     | 0.040 | 0.84        | 1.01 |
| F   | 0.037     | 0.047 | 0.94        | 1.19 |
| 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   | 0.175     | 0.215 | 4.45        | 5.46 |
| S   | 0.050     | 0.090 | 1.27        | 2.28 |
| V   | 0.030     | 0.050 | 0.77        | 1.27 |

STYLE 1:  
PIN 1. BASE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

STYLE 2:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE  
4. DRAIN

STYLE 3:  
PIN 1. ANODE  
2. CATHODE  
3. ANODE  
4. CATHODE

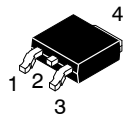
STYLE 4:  
PIN 1. CATHODE  
2. ANODE  
3. GATE  
4. ANODE

STYLE 5:  
PIN 1. GATE  
2. ANODE  
3. CATHODE  
4. ANODE

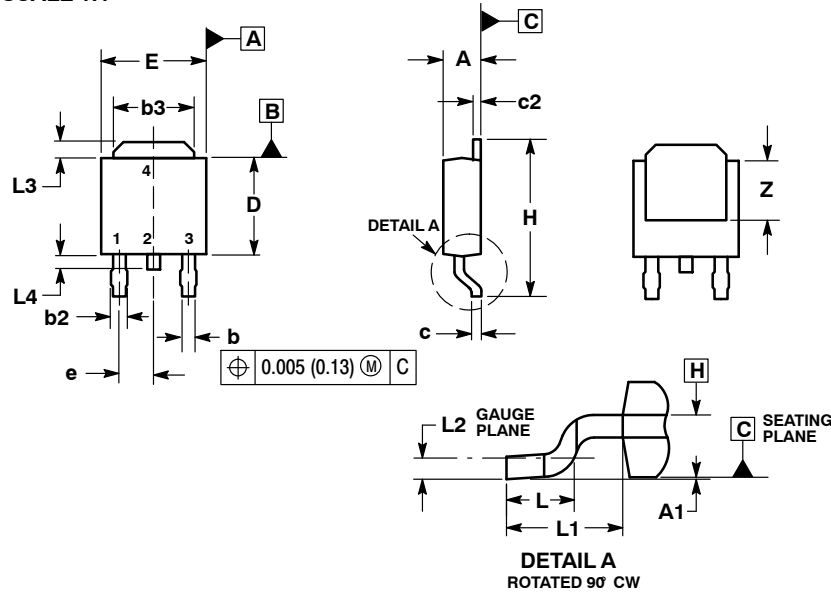
STYLE 6:  
PIN 1. MT1  
2. MT2  
3. GATE  
4. MT2

|                  |                      |                                                                                                                                                                                  |
|------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| DESCRIPTION:     | DPAK INSERTION MOUNT | PAGE 1 OF 1                                                                                                                                                                      |

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SCALE 1:1



STYLE 1:  
PIN 1. BASE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

STYLE 2:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE  
4. DRAIN

STYLE 3:  
PIN 1. ANODE  
2. CATHODE  
3. ANODE  
4. CATHODE

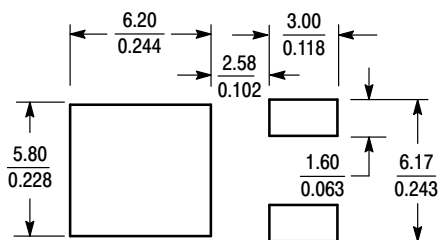
STYLE 4:  
PIN 1. CATHODE  
2. ANODE  
3. GATE  
4. ANODE

STYLE 5:  
PIN 1. GATE  
2. ANODE  
3. CATHODE  
4. ANODE

STYLE 6:  
PIN 1. MT1  
2. MT2  
3. GATE  
4. MT2

STYLE 7:  
PIN 1. GATE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

#### SOLDERING FOOTPRINT\*



SCALE 3:1 (mm/inches)

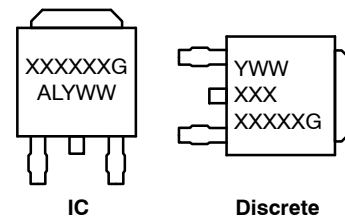
\*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

#### NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
- CONTROLLING DIMENSION: INCHES.
- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
- 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.
- DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- 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        |       |

#### GENERIC MARKING DIAGRAM\*



XXXXXX = Device Code  
A = Assembly Location  
L = Wafer Lot  
Y = Year  
WW = Work Week  
G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking.

|                  |                     |                                                                                                                                                                                     |
|------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| DESCRIPTION:     | DPAK (SINGLE GAUGE) | PAGE 1 OF 1                                                                                                                                                                         |

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