

# 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  | $V_{DSS}$       | 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.

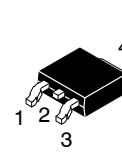
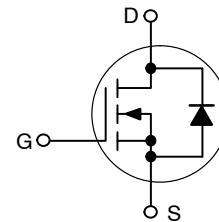


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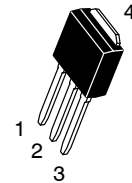
<http://onsemi.com>

45 AMPERES, 25 VOLTS  
 $R_{DS(on)} = 12.6 \text{ m}\Omega$  (Typ)

### N-CHANNEL

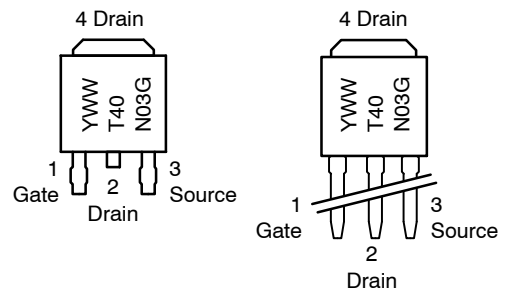


CASE 369AA  
 DPAK  
 (Surface Mount)  
 STYLE 2



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<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)DSS</sub> | 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>- | 1.7<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> = 10 Adc)<br>(V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 10 Adc) | R <sub>DS(on)</sub> | -<br>-   | 18.6<br>12.6 | 23<br>16.5 | mΩ           |
| Forward Transconductance (Note 3)<br>(V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 10 Adc)   | g <sub>FS</sub>     | -        | 20           | -          | Mhos         |

### DYNAMIC CHARACTERISTICS

|                      |  |                  |   |     |   |    |
|----------------------|--|------------------|---|-----|---|----|
| Input Capacitance    | (V <sub>DS</sub> = 20 Vdc, V <sub>GS</sub> = 0 V, f = 1 MHz) | C <sub>iss</sub> | - | 584 | - | pF |
| Output Capacitance   |  | C <sub>oss</sub> | - | 254 | - |    |
| Transfer Capacitance |  | C <sub>rss</sub> | - | 99  | - |    |

### 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> = 10 Adc, R <sub>G</sub> = 3 Ω) | t <sub>d(on)</sub>  | - | 4.5  | - | ns |
| Rise Time           |  | t <sub>r</sub>      | - | 19.5 | - |    |
| Turn-Off Delay Time |  | t <sub>d(off)</sub> | - | 16.7 | - |    |
| Fall Time           |  | t <sub>f</sub>      | - | 3.5  | - |    |
| Gate Charge         | (V <sub>GS</sub> = 4.5 Vdc, I <sub>D</sub> = 10 Adc,<br>V <sub>DS</sub> = 10 Vdc) (Note 3)             | Q <sub>T</sub>      | - | 5.78 | - | nC |
|                     |  | Q <sub>1</sub>      | - | 2.1  | - |    |
|                     |  | Q <sub>2</sub>      | - | 2.5  | - |    |

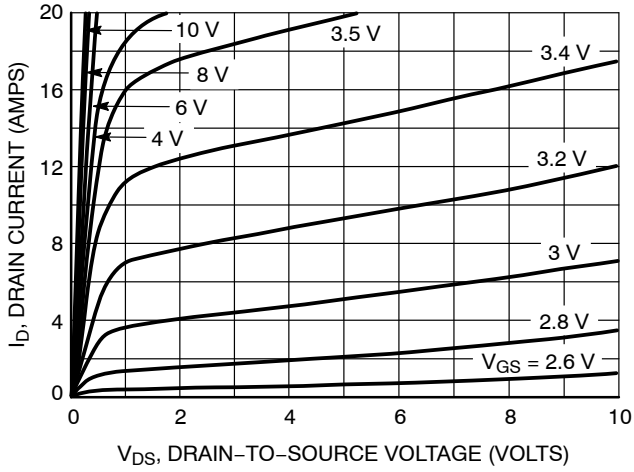
### SOURCE-DRAIN DIODE CHARACTERISTICS

|                                |   |                 |        |              |          |     |
|--------------------------------|---|-----------------|--------|--------------|----------|-----|
| Forward On-Voltage             | (I <sub>S</sub> = 10 Adc, V <sub>GS</sub> = 0 Vdc) (Note 3)<br>(I <sub>S</sub> = 10 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C) | V <sub>SD</sub> | -<br>- | 0.85<br>0.71 | 1.2<br>- | Vdc |
| Reverse Recovery Time          | (I <sub>S</sub> = 10 Adc, V <sub>GS</sub> = 0 Vdc,<br>di <sub>S</sub> /dt = 100 A/μs) (Note 3)  | t <sub>rr</sub> | -      | 20.4         | -        | ns  |
|                                |   | t <sub>a</sub>  | -      | 8.25         | -        |     |
|                                |   | t <sub>b</sub>  | -      | 12.1         | -        |     |
| Reverse Recovery Stored Charge |   | Q <sub>RR</sub> | -      | 0.007        | -        | μC  |

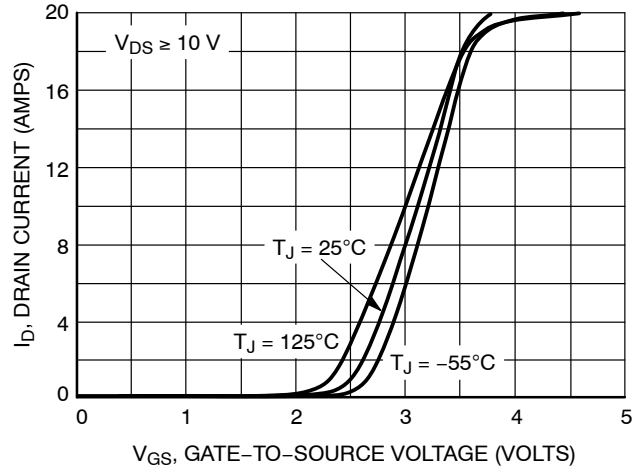
3. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

4. Switching characteristics are independent of operating junction temperatures.

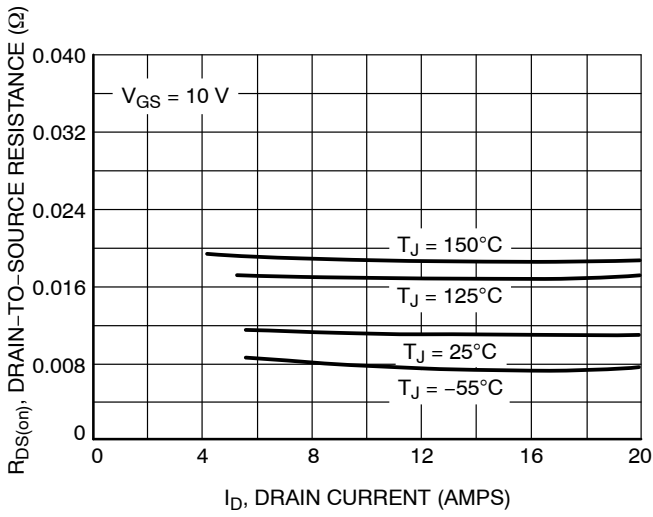
# NTD40N03R



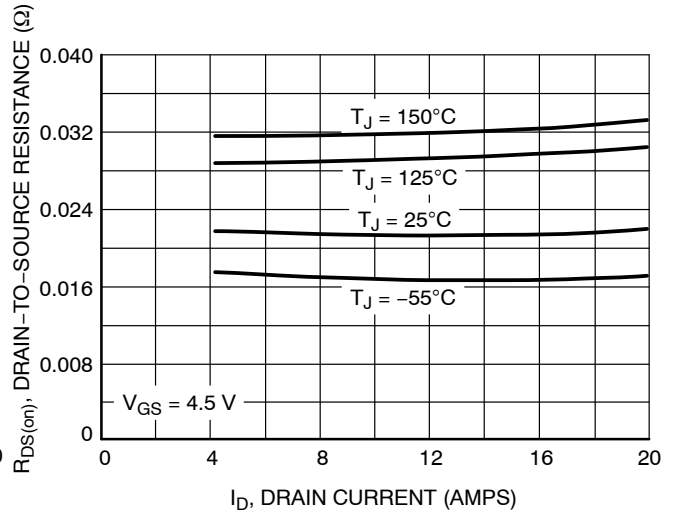
**Figure 1. On-Region Characteristics**



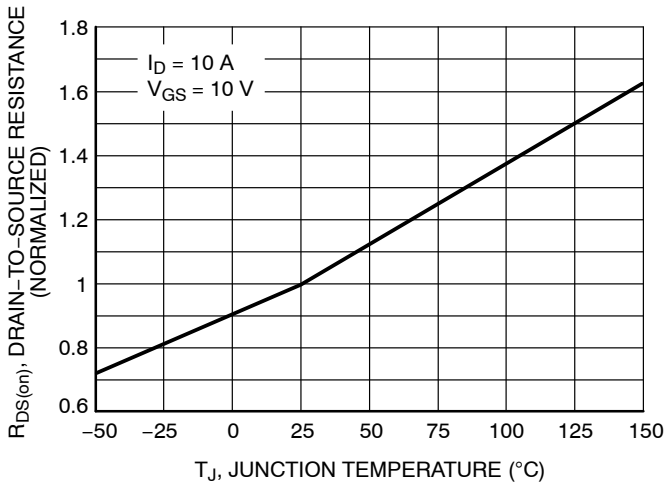
**Figure 2. Transfer Characteristics**



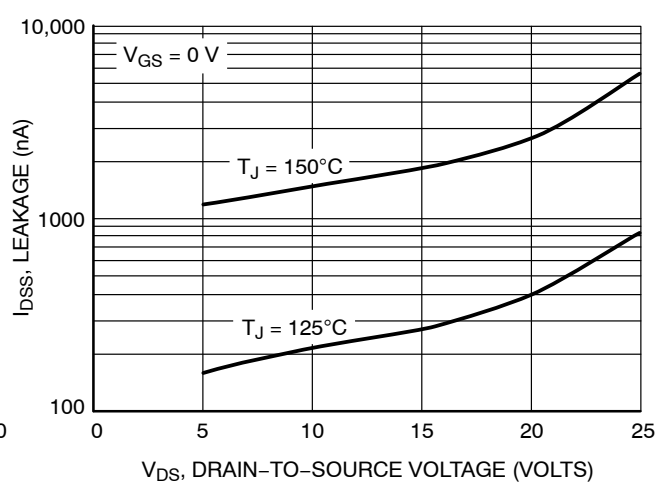
**Figure 3. On-Resistance versus Drain Current and Temperature**



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

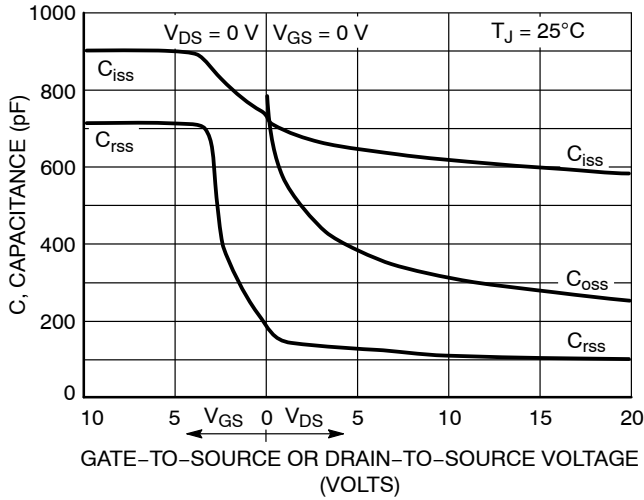


**Figure 5. On-Resistance Variation with Temperature**

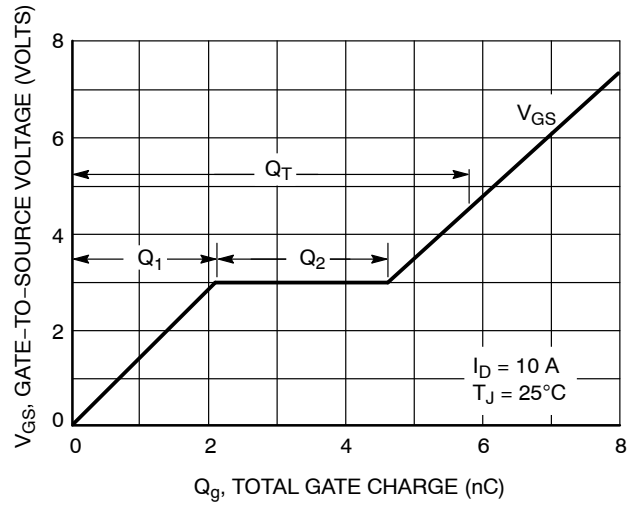


**Figure 6. Drain-to-Source Leakage Current versus Voltage**

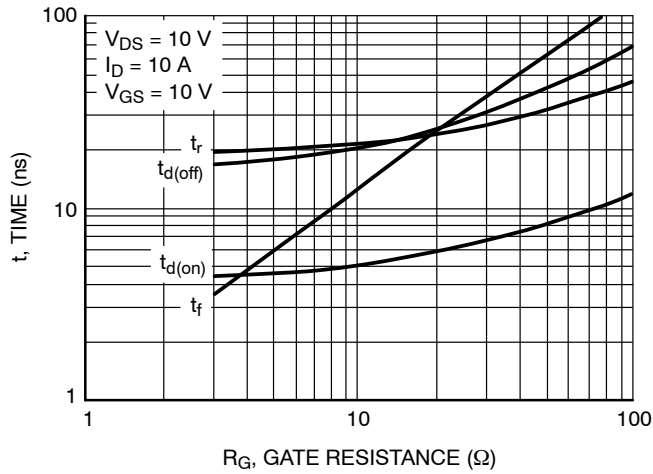
# NTD40N03R



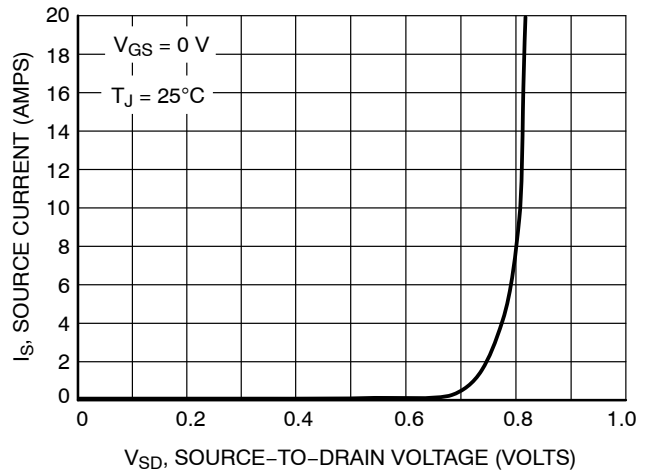
**Figure 7. Capacitance Variation**



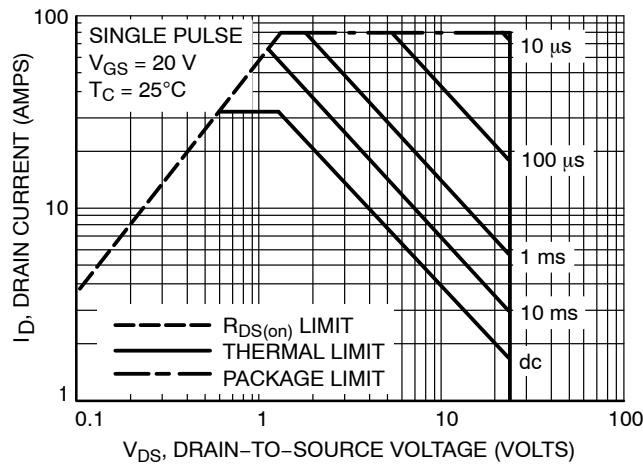
**Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge**



**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

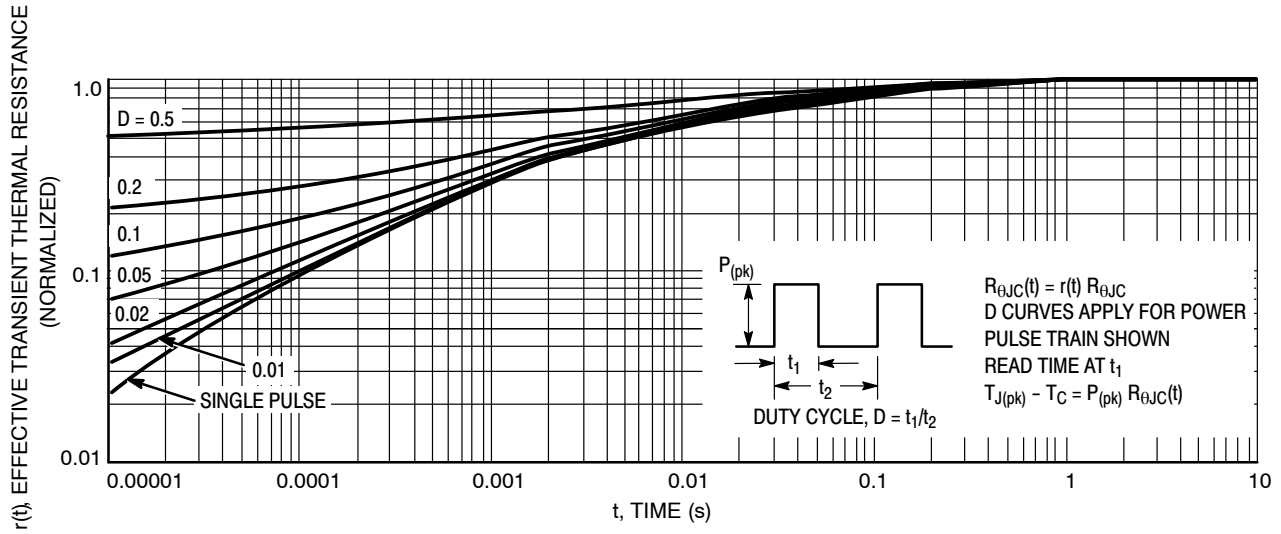


Figure 12. Thermal Response

## ORDERING INFORMATION

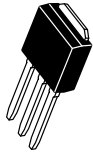
| Device       | Package                           | Shipping <sup>†</sup> |
|--------------|-----------------------------------|-----------------------|
| NTD40N03R-1G | DPAK (Straight Lead)<br>(Pb-Free) | 75 Units/Rail         |
| NTD40N03RT4G | DPAK<br>(Pb-Free)                 | 2500 Tape & Reel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

<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.

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

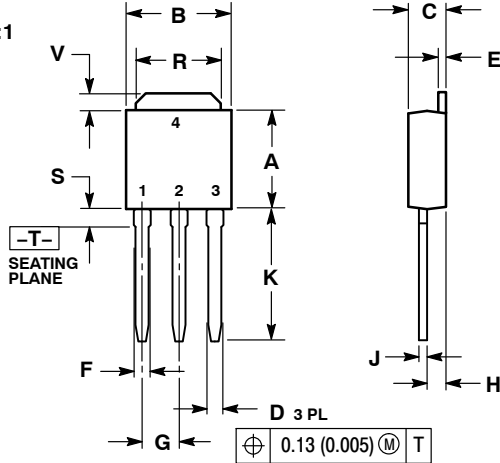
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### IPAK CASE 369D-01 ISSUE C

DATE 15 DEC 2010

SCALE 1:1

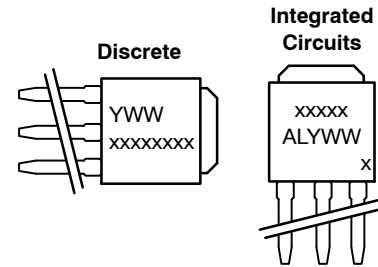


- NOTES:
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  - CONTROLLING DIMENSION: INCH.

| 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        | ---  |

- |  |   |  |  |
|--|---|--|--|
| <p>STYLE 1:<br/>PIN 1. BASE<br/>2. COLLECTOR<br/>3. EMITTER<br/>4. COLLECTOR</p> | <p>STYLE 2:<br/>PIN 1. GATE<br/>2. DRAIN<br/>3. SOURCE<br/>4. DRAIN</p> | <p>STYLE 3:<br/>PIN 1. ANODE<br/>2. CATHODE<br/>3. ANODE<br/>4. CATHODE</p>      | <p>STYLE 4:<br/>PIN 1. CATHODE<br/>2. ANODE<br/>3. GATE<br/>4. ANODE</p> |
| <p>STYLE 5:<br/>PIN 1. GATE<br/>2. ANODE<br/>3. CATHODE<br/>4. ANODE</p>         | <p>STYLE 6:<br/>PIN 1. MT1<br/>2. MT2<br/>3. GATE<br/>4. MT2</p>        | <p>STYLE 7:<br/>PIN 1. GATE<br/>2. COLLECTOR<br/>3. EMITTER<br/>4. COLLECTOR</p> |  |

### MARKING DIAGRAMS



- xxxxxxxxx = Device Code  
A = Assembly Location  
IL = Wafer Lot  
Y = Year  
WW = Work Week

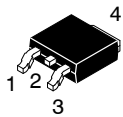
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| <b>DESCRIPTION:</b>     | <b>IPAK (DPAK INSERTION MOUNT)</b> | <b>PAGE 1 OF 1</b>   |

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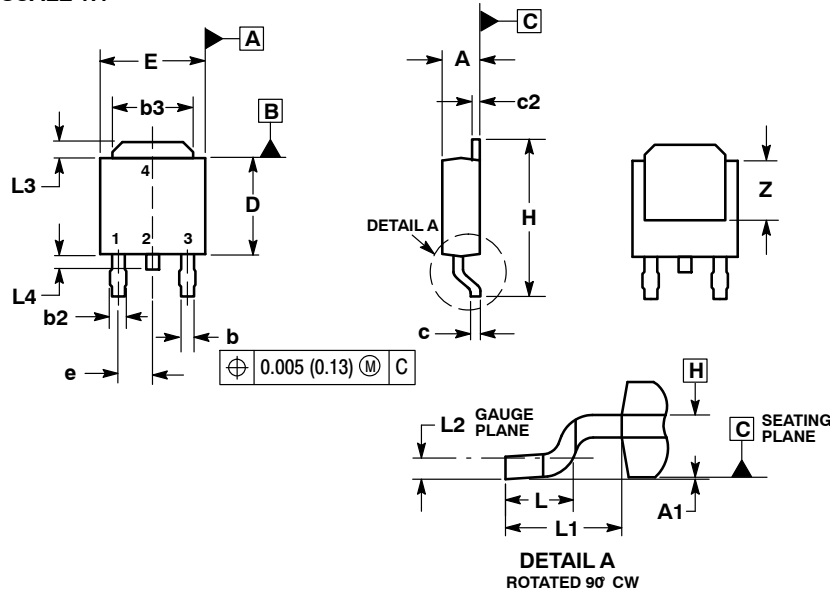
# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

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SCALE 1:1



### DPAK (SINGLE GAUGE)

#### CASE 369AA-01

#### ISSUE B

DATE 03 JUN 2010

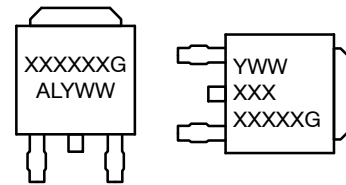
NOTES:

- 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        | ---   |

- |  |   |  |  |
|--|---|--|--|
| <p>STYLE 1:<br/>PIN 1. BASE<br/>2. COLLECTOR<br/>3. EMITTER<br/>4. COLLECTOR</p> | <p>STYLE 2:<br/>PIN 1. GATE<br/>2. DRAIN<br/>3. SOURCE<br/>4. DRAIN</p> | <p>STYLE 3:<br/>PIN 1. ANODE<br/>2. CATHODE<br/>3. ANODE<br/>4. CATHODE</p>      | <p>STYLE 4:<br/>PIN 1. CATHODE<br/>2. ANODE<br/>3. GATE<br/>4. ANODE</p> |
| <p>STYLE 5:<br/>PIN 1. GATE<br/>2. ANODE<br/>3. CATHODE<br/>4. ANODE</p>         | <p>STYLE 6:<br/>PIN 1. MT1<br/>2. MT2<br/>3. GATE<br/>4. MT2</p>        | <p>STYLE 7:<br/>PIN 1. GATE<br/>2. COLLECTOR<br/>3. EMITTER<br/>4. COLLECTOR</p> |  |

### GENERIC MARKING DIAGRAM\*



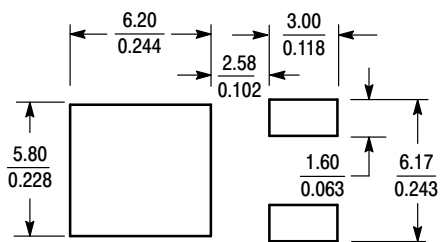
IC

Discrete

- 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.

### 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.

|                         |                            |  |
|-------------------------|----------------------------|--|
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| <b>DESCRIPTION:</b>     | <b>DPAK (SINGLE GAUGE)</b> | <b>PAGE 1 OF 1</b>   |

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