



**THE DATASHEET OF
NTD50N03R-1G**



NTD50N03R

Power MOSFET 25 V, 45 A, Single N-Channel, DPAK

Features

- Planar Technology
- Low $R_{DS(on)}$ to Minimize Conduction Losses
- Low Capacitance to Minimize Driver Losses
- Optimized Gate Charge to Minimize Switching Losses
- Pb-Free Packages are Available

Applications

- VCORE DC-DC Buck Converter Applications
- Optimized for High Side Switching

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

| Parameter | Symbol | Value | Unit | |
|--|----------------|--------------------------|------------------|---|
| Drain-to-Source Voltage | V_{DSS} | 25 | V | |
| Gate-to-Source Voltage | V_{GS} | ± 20 | V | |
| Continuous Drain Current ($R_{\theta JA}$) (Note 1) | I_D | $T_A = 25^\circ\text{C}$ | 9.2 | A |
| | | $T_A = 85^\circ\text{C}$ | 7.2 | |
| Power Dissipation ($R_{\theta JA}$) (Note 1) | P_D | $T_A = 25^\circ\text{C}$ | 2.1 | W |
| | | $T_A = 85^\circ\text{C}$ | | |
| Continuous Drain Current ($R_{\theta JA}$) (Note 2) | I_D | $T_A = 25^\circ\text{C}$ | 7.8 | A |
| | | $T_A = 85^\circ\text{C}$ | 6.0 | |
| Power Dissipation ($R_{\theta JA}$) (Note 2) | P_D | $T_A = 25^\circ\text{C}$ | 1.5 | W |
| | | $T_A = 85^\circ\text{C}$ | | |
| Continuous Drain Current ($R_{\theta JC}$) (Note 1) | I_D | $T_C = 25^\circ\text{C}$ | 45 | A |
| | | $T_C = 85^\circ\text{C}$ | 35 | |
| Power Dissipation ($R_{\theta JC}$) (Note 1) | P_D | $T_C = 25^\circ\text{C}$ | 50 | W |
| | | $T_C = 85^\circ\text{C}$ | | |
| Pulsed Drain Current | I_{DM} | 180 | A | |
| Current Limited by Package | $I_{DmaxPkg}$ | 45 | A | |
| Operating Junction and Storage Temperature | T_J, T_{stg} | -55 to 175 | $^\circ\text{C}$ | |
| Source Current (Body Diode) | I_S | 45 | A | |
| Drain-to-Source (dv/dt) | dv/dt | 8.0 | V/ns | |
| Single Pulse Drain-to-Source Avalanche Energy ($T_J = 25^\circ\text{C}$, $V_{DD} = 50\text{ V}$, $V_{GS} = 10\text{ V}$, $I_L = 6.32\text{ A}_{pk}$, $L = 1.0\text{ mH}$, $R_G = 25\ \Omega$) | E_{AS} | 20 | mJ | |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s) | 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. Surface-mounted on FR4 board using 1 sq in pad, 1 oz Cu.
2. Surface-mounted on FR4 board using the minimum recommended pad size.

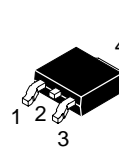
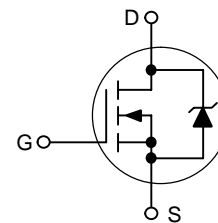


ON Semiconductor®

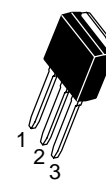
<http://onsemi.com>

| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP | I_D MAX |
|---------------|------------------------|-----------|
| 25 V | 12.5 m Ω @ 10 V | 45 A |
| | 19 m Ω @ 4.5 V | |

N-Channel



CASE 369AA
DPAK
(Surface Mount)
STYLE 2

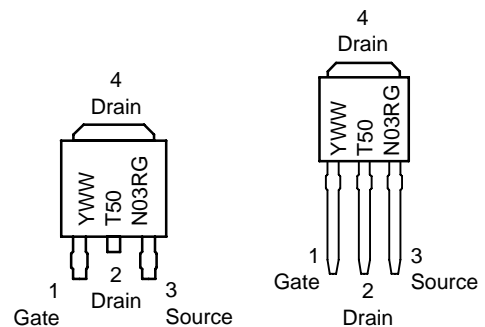


CASE 369D
DPAK
(Straight Lead)
STYLE 2



CASE 369AC
3 IPAK
(Straight Lead)

MARKING DIAGRAMS & PIN ASSIGNMENTS



Y = Year
WW = Work Week
T50N03R = Device Code
G = Pb-Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

NTD50N03R

THERMAL RESISTANCE MAXIMUM RATINGS

| Parameter | Symbol | Value | Unit |
|---|-----------------|-------|------|
| Junction-to-Case (Drain) | $R_{\theta JC}$ | 3.0 | °C/W |
| Junction-to-Ambient – Steady State (Note 3) | $R_{\theta JA}$ | 71.4 | |
| Junction-to-Ambient – Steady State (Note 4) | $R_{\theta JA}$ | 100 | |

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

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|-----------|--------|----------------|-----|-----|-----|------|
|-----------|--------|----------------|-----|-----|-----|------|

OFF CHARACTERISTICS

| | | | | | | |
|---|-------------------|---|---------------------------|-----|-----------|---------------|
| Drain-to-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$ | 25 | | | V |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | | | -16 | | mV/°C |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}$ | $T_J = 25^\circ\text{C}$ | | 1.5 | μA |
| | | | $T_J = 125^\circ\text{C}$ | | 10 | |
| Gate-to-Source Leakage Current | I_{GSS} | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$ | | | ± 100 | nA |

ON CHARACTERISTICS (Note 5)

| | | | | | | | |
|--|------------------|---|---------------------|------|------|------------------|----|
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$ | 1.0 | 1.7 | 2.0 | V | |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ | | | -5.0 | | mV/°C | |
| Drain-to-Source On Resistance | $R_{DS(on)}$ | $V_{GS} = 11.5\text{ V}$ | $I_D = 30\text{ A}$ | | 12 | $\text{m}\Omega$ | |
| | | | $I_D = 15\text{ A}$ | | 11.7 | | |
| | | $V_{GS} = 10\text{ V}$ | $I_D = 30\text{ A}$ | | 12.5 | | 14 |
| | | | $I_D = 15\text{ A}$ | | 19 | | 23 |
| Forward Transconductance | g_{FS} | $V_{DS} = 15\text{ V}, I_D = 15\text{ A}$ | | 15 | | S | |

CHARGES, CAPACITANCES AND GATE RESISTANCE

| | | | | | | |
|------------------------------|--------------|---|--|-----|-----|-------------|
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 12\text{ V}$ | | 610 | 750 | pF |
| Output Capacitance | C_{oss} | | | 300 | | |
| Reverse Transfer Capacitance | C_{rss} | | | 125 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 30\text{ A}$ | | 6.0 | 10 | nC |
| Threshold Gate Charge | $Q_{G(TH)}$ | | | 0.9 | | |
| Gate-to-Source Charge | Q_{GS} | | | 1.9 | | |
| Gate-to-Drain Charge | Q_{GD} | | | 3.7 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS} = 11.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 30\text{ A}$ | | 15 | | nC |
| Threshold Gate Charge | $Q_{G(TH)}$ | | | 1.0 | | |
| Gate-to-Source Charge | Q_{GS} | | | 1.9 | | |
| Gate-to-Drain Charge | Q_{GD} | | | 3.9 | | |

- Surface-mounted on FR4 board using 1 sq in pad, 1 oz Cu.
- Surface-mounted on FR4 board using the minimum recommended pad size.
- Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle $\leq 2\%$.

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

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|-----------|--------|----------------|-----|-----|-----|------|
|-----------|--------|----------------|-----|-----|-----|------|

SWITCHING CHARACTERISTICS (Note 6)

| | | | | | | |
|---------------------|--------------|---|--|------|--|----|
| Turn-On Delay Time | $t_{d(on)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V},$ $I_D = 30\text{ A}, R_G = 3.0\ \Omega$ | | 8.2 | | ns |
| Rise Time | t_r | | | 9.6 | | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 11.2 | | |
| Fall Time | t_f | | | 6.8 | | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{GS} = 11.5\text{ V}, V_{DS} = 15\text{ V},$ $I_D = 30\text{ A}, R_G = 3.0\ \Omega$ | | 5.0 | | ns |
| Rise Time | t_r | | | 84 | | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 15 | | |
| Fall Time | t_f | | | 4.0 | | |

DRAIN-SOURCE DIODE CHARACTERISTICS

| | | | | | | | |
|-------------------------|----------|---|---------------------------|------|------|-----|---|
| Forward Diode Voltage | V_{SD} | $V_{GS} = 0\text{ V},$ $I_S = 30\text{ A}$ | $T_J = 25^\circ\text{C}$ | | 0.85 | 1.1 | V |
| | | | $T_J = 125^\circ\text{C}$ | | 0.71 | | |
| Reverse Recovery Time | t_{RR} | $V_{GS} = 0\text{ V}, dt_S/dt = 100\text{ A}/\mu\text{s},$ $I_S = 30\text{ A}$ | | 24 | | ns | |
| Charge Time | t_a | | | 14 | | | |
| Discharge Time | t_b | | | 10.5 | | | |
| Reverse Recovery Charge | Q_{RR} | | | 14 | | nC | |

PACKAGE PARASITIC VALUES

| | | | | | | |
|-------------------|-------|--------------------|--|------|--|----|
| Source Inductance | L_S | $T_a = 25\text{C}$ | | 2.49 | | nH |
| Drain Inductance | L_D | | | 0.02 | | |
| Gate Inductance | L_G | | | 3.46 | | |
| Gate Resistance | R_G | | | 3.75 | | |

6. Switching characteristics are independent of operating junction temperatures.

NTD50N03R

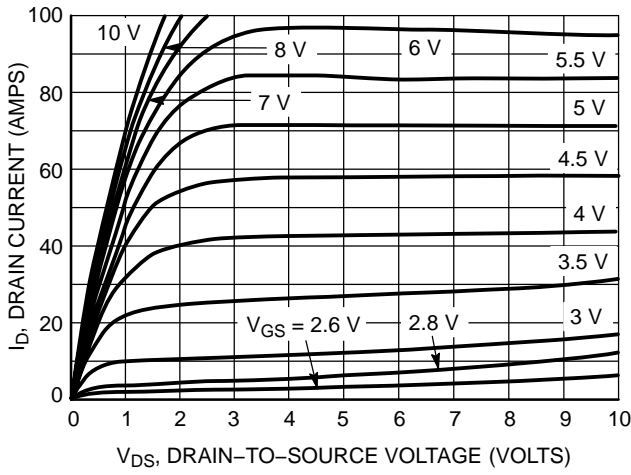


Figure 1. On-Region Characteristics

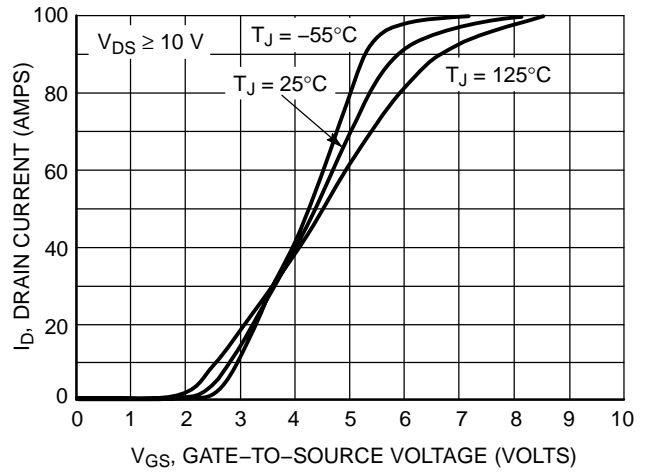


Figure 2. Transfer Characteristics

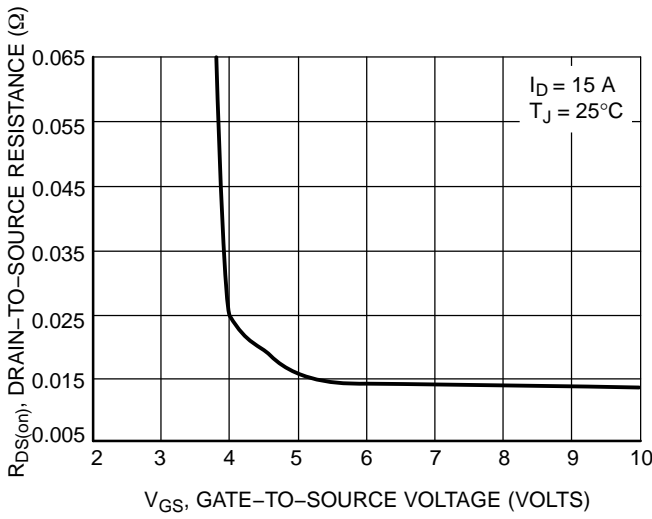


Figure 3. On-Resistance versus Gate-to-Source Voltage

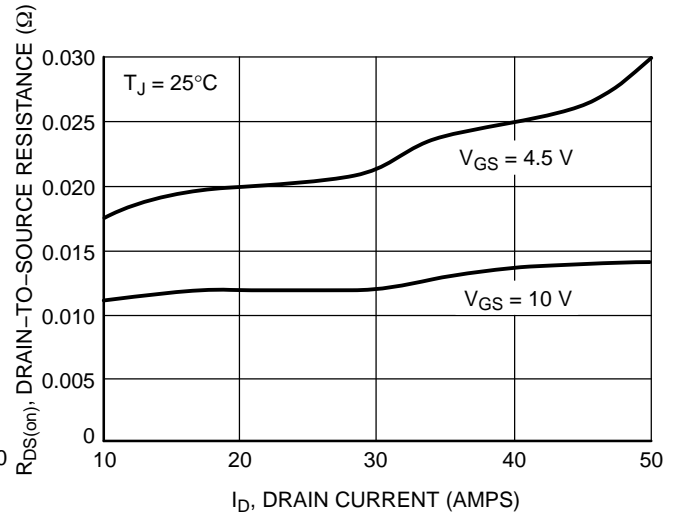


Figure 4. On-Resistance versus Drain Current and Gate Voltage

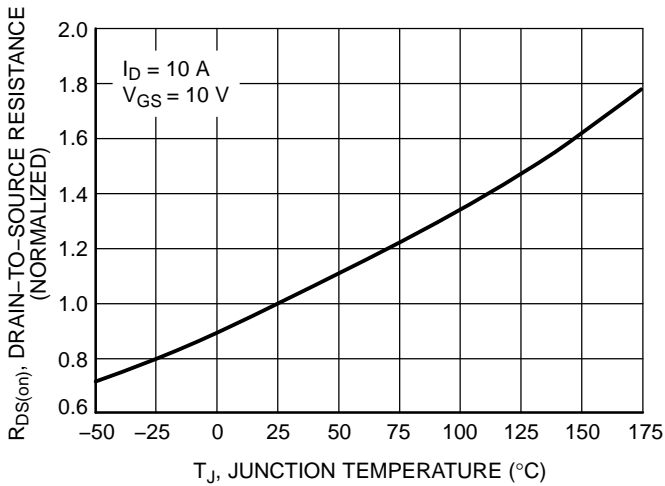


Figure 5. On-Resistance Variation with Temperature

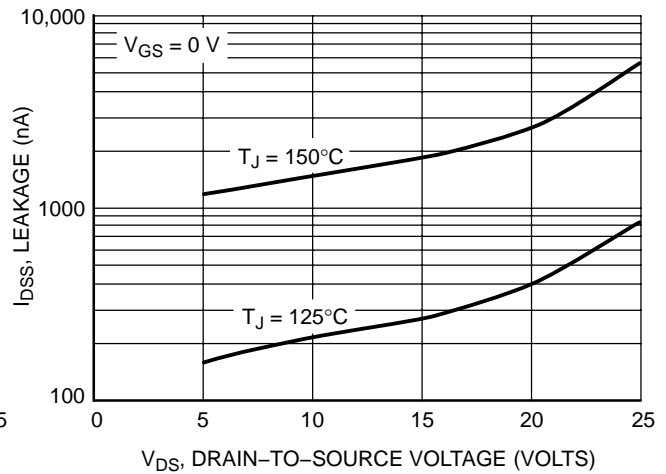


Figure 6. Drain-to-Source Leakage Current versus Voltage

NTD50N03R

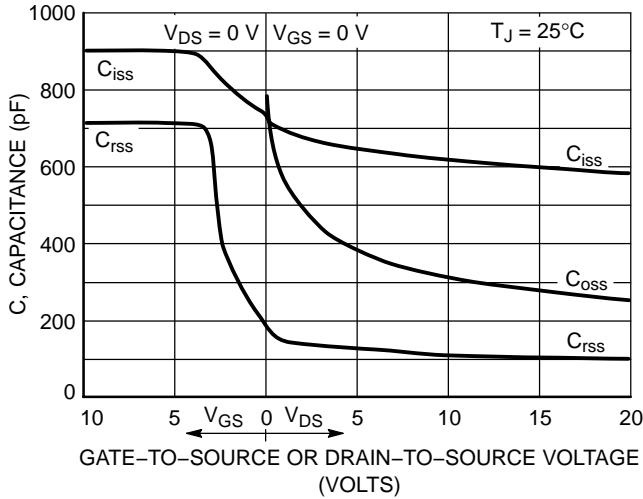


Figure 7. Capacitance Variation

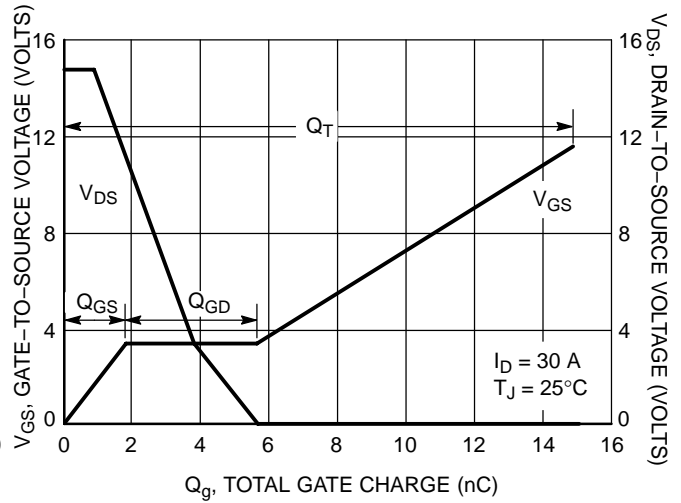


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

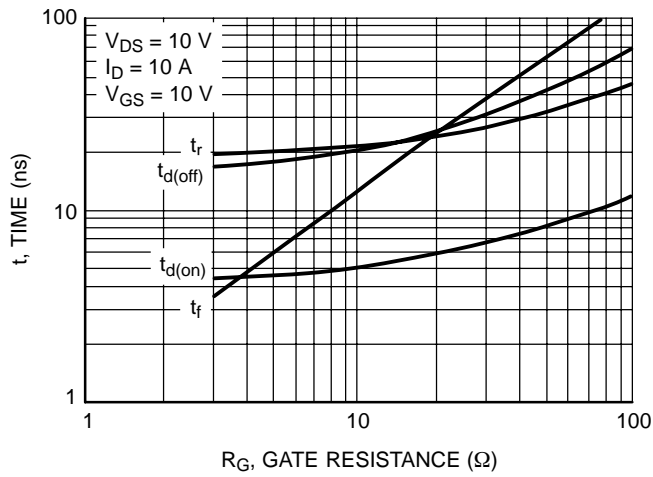


Figure 9. Resistive Switching Time Variation versus Gate Resistance

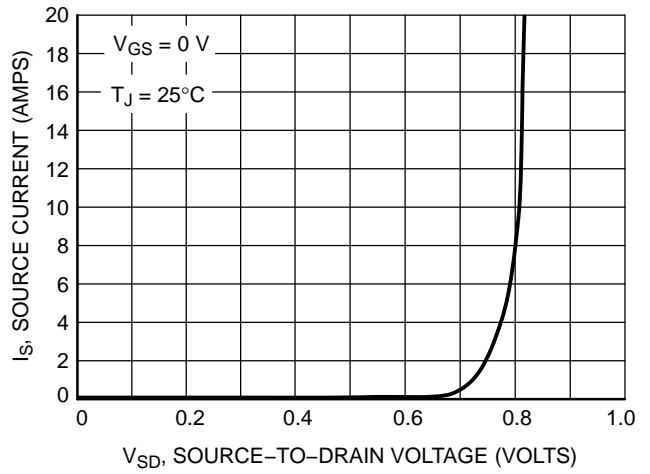


Figure 10. Diode Forward Voltage versus Current

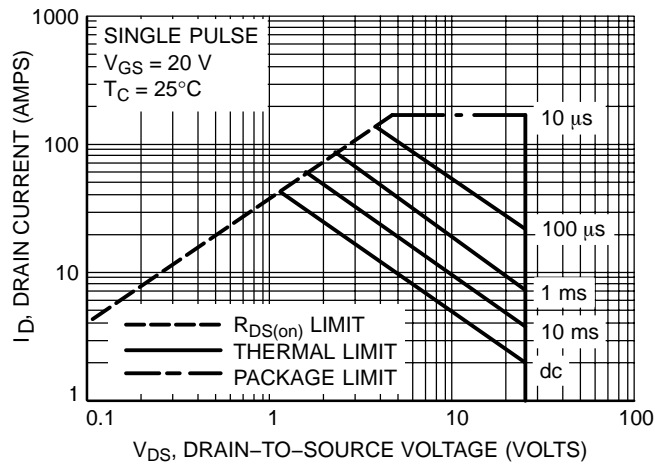


Figure 11. Maximum Rated Forward Biased Safe Operating Area

NTD50N03R

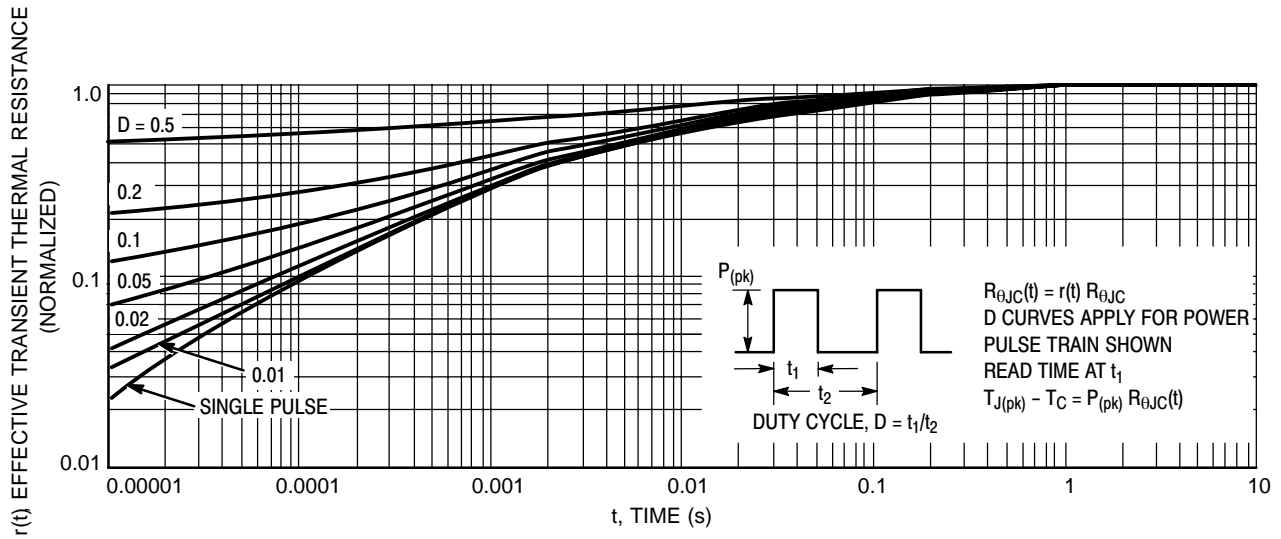


Figure 12. Thermal Response

ORDERING INFORMATION

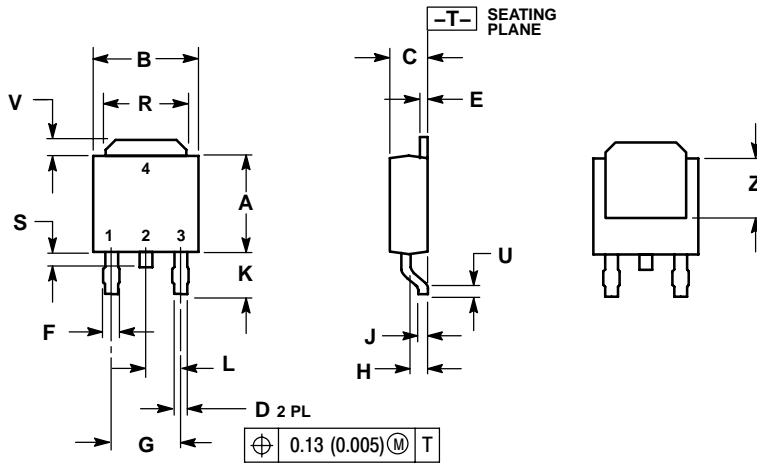
| Order Number | Package | Shipping [†] |
|---------------|--|-----------------------|
| NTD50N03R | DPAK-3 | 75 Units / Rail |
| NTD50N03RG | DPAK-3 (Pb-Free) | 75 Units / Rail |
| NTD50N03RT4 | DPAK-3 | 2500 / Tape & Reel |
| NTD50N03RT4G | DPAK-3 (Pb-Free) | 2500 / Tape & Reel |
| NTD50N03R-1 | DPAK-3 Straight Lead | 75 Units / Rail |
| NTD50N03R-1G | DPAK-3 Straight Lead (Pb-Free) | 75 Units / Rail |
| NTD50N03R-35 | DPAK-3 Straight Lead Trimmed (3.5 ± 0.15 mm) | 75 Units / Rail |
| NTD50N03R-35G | DPAK-3 Straight Lead Trimmed (3.5 ± 0.15 mm) (Pb-Free) | 75 Units / Rail |

[†]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.

NTD50N03R

PACKAGE DIMENSIONS

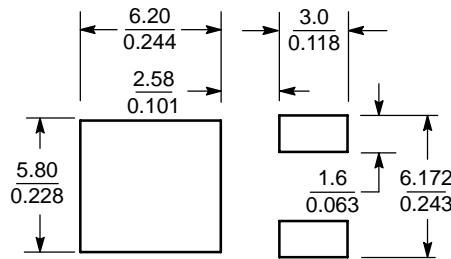
DPAK
CASE 369C-01
ISSUE O



- 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 | 0.027 | 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 | 0.180 BSC | | 4.58 BSC | |
| H | 0.034 | 0.040 | 0.87 | 1.01 |
| J | 0.018 | 0.023 | 0.46 | 0.58 |
| K | 0.102 | 0.114 | 2.60 | 2.89 |
| L | 0.090 BSC | | 2.29 BSC | |
| R | 0.180 | 0.215 | 4.57 | 5.45 |
| S | 0.025 | 0.040 | 0.63 | 1.01 |
| U | 0.020 | --- | 0.51 | --- |
| V | 0.035 | 0.050 | 0.89 | 1.27 |
| Z | 0.155 | --- | 3.93 | --- |

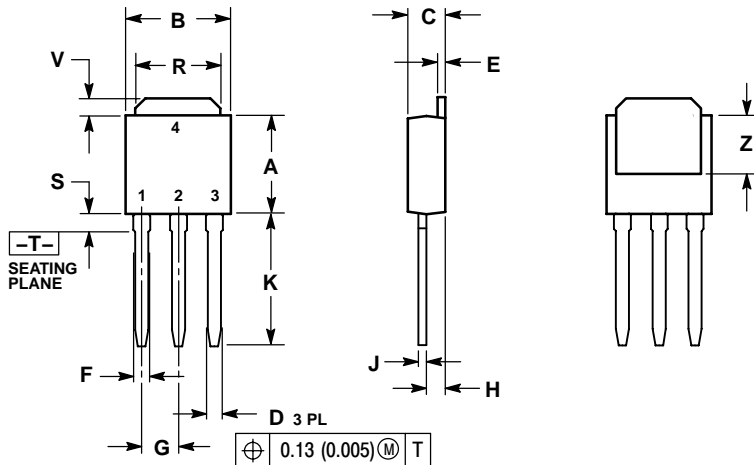
SOLDERING FOOTPRINT*



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.

DPAK
CASE 369D-01
ISSUE B



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

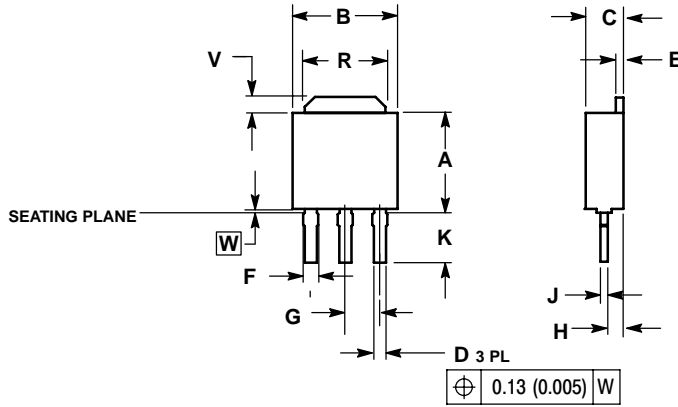
| DIM | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|------|
| | MIN | MAX | MIN | MAX |
| A | 0.235 | 0.245 | 5.97 | 6.35 |
| B | 0.250 | 0.265 | 6.35 | 6.73 |
| C | 0.086 | 0.094 | 2.19 | 2.38 |
| D | 0.027 | 0.035 | 0.69 | 0.88 |
| E | 0.018 | 0.023 | 0.46 | 0.58 |
| F | 0.037 | 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
2. DRAIN
3. SOURCE
4. DRAIN

NTD50N03R

PACKAGE DIMENSIONS

3 IPAK, STRAIGHT LEAD CASE 369AC-01 ISSUE O



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. SEATING PLANE IS ON TOP OF DAMBAR POSITION.
4. DIMENSION A DOES NOT INCLUDE DAMBAR POSITION OR MOLD GATE.

| 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 | 0.027 | 0.035 | 0.69 | 0.88 |
| E | 0.018 | 0.023 | 0.46 | 0.58 |
| F | 0.037 | 0.043 | 0.94 | 1.09 |
| 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 | 0.134 | 0.142 | 3.40 | 3.60 |
| R | 0.180 | 0.215 | 4.57 | 5.46 |
| V | 0.035 | 0.050 | 0.89 | 1.27 |
| W | 0.000 | 0.010 | 0.000 | 0.25 |

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