# NTB125N02R, NTP125N02R

# Power MOSFET
# 125 A, 24 V N-Channel
# TO-220, D²PAK

**Features**

- Planar HD3e Process for Fast Switching Performance
- Body Diode for Low $t_{rr}$ and $Q_{rr}$ and Optimized for Synchronous Operation
- Low $C_{iss}$ to Minimize Driver Loss
- Optimized $Q_{gd}$ and $R_{DS(on)}$ for Shoot−through Protection
- Low Gate Charge

**MAXIMUM RATINGS** ($T_J$ = 25°C Unless otherwise specified)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain−to−Source Voltage | $V_{DSS}$ | 24 | $V_{dc}$ |
| Gate−to−Source Voltage − Continuous | $V_{GS}$ | ±20 | $V_{dc}$ |
| Thermal Resistance − Junction−to−Case<br>Total Power Dissipation @ $T_C$ = 25°C<br>Drain Current −<br>Continuous @ $T_C$ = 25°C, Chip<br>Continuous @ $T_C$ = 25°C, Limited by Package<br>Continuous @ $T_A$ = 25°C, Limited by Wires<br>Single Pulse ($t_p$ = 10 μs) | $R_{\theta JC}$<br>$P_D$<br><br>$I_D$<br>$I_D$<br>$I_D$<br>$I_D$ | 1.1<br>113.6<br><br>125<br>120.5<br>95<br>250 | °C/W<br>W<br><br>A<br>A<br>A<br>A |
| Thermal Resistance −<br>Junction−to−Ambient (Note 1)<br>Total Power Dissipation @ $T_A$ = 25°C<br>Drain Current − Continuous @ $T_A$ = 25°C | $R_{\theta JA}$<br>$P_D$<br>$I_D$ | 46<br>2.72<br>18.6 | °C/W<br>W<br>A |
| Thermal Resistance −<br>Junction−to−Ambient (Note 2)<br>Total Power Dissipation @ $T_A$ = 25°C<br>Drain Current − Continuous @ $T_A$ = 25°C | $R_{\theta JA}$<br>$P_D$<br>$I_D$ | 63<br>1.98<br>15.9 | °C/W<br>W<br>A |
| Operating and Storage Temperature Range | $T_J$, $T_{stg}$ | −55 to 150 | °C |
| Single Pulse Drain−to−Source Avalanche Energy − Starting $T_J$ = 25°C ($V_{DD}$ = 50 $V_{dc}$, $V_{GS}$ = 10 $V_{dc}$, $I_L$ = 15.5 $A_{pk}$, L = 1 mH, $R_G$ = 25 Ω) | $E_{AS}$ | 120 | mJ |
| Maximum Lead Temperature for Soldering Purposes, 1/8″ from Case for 10 Seconds | $T_L$ | 260 | °C |

1. When surface mounted to an FR4 board using 1 inch pad size, (Cu Area 1.127 $in^2$).
2. When surface mounted to an FR4 board using minimum recommended pad size, (Cu Area 0.412 $in^2$).

**PIN ASSIGNMENT**

| PIN | FUNCTION |
|---|---|
| 1 | Gate |
| 2 | Drain |
| 3 | Source |
| 4 | Drain |

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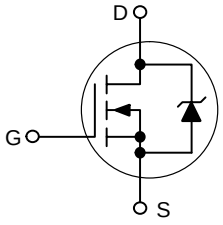
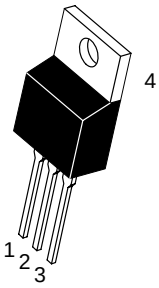
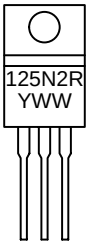
**125 AMPERES, 24 VOLTS**
**$R_{DS(on)}$ = 3.7 mΩ (Typ)**

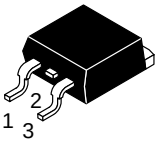



**MARKING DIAGRAMS**

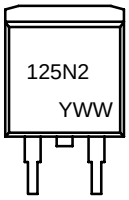



**TO−220AB**
**CASE 221A**
**STYLE 5**




**D²PAK**
**CASE 418AA**
**STYLE 2**




125N2 = Specific Device Code
Y = Year
WW = Work Week

**ORDERING INFORMATION**

| Device | Package | Shipping† |
|---|---|---|
| NTB125N02R | D²PAK | 50 Units/Rail |
| NTB125N02RT4 | D²PAK | 800/Tape & Reel |
| NTP125N02R | TO−220AB | 50 Units/Rail |

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

**ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C Unless otherwise specified)

| Characteristics | | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| Drain−to−Source Breakdown Voltage (Note 3)<br>($V_{GS}$ = 0 $V_{dc}$, $I_D$ = 250 $\mu A_{dc}$)<br>Temperature Coefficient (Positive) | | $V_{(BR)DSS}$ | <br>25<br>– | <br>28<br>15 | <br>–<br>– | $V_{dc}$<br><br>mV/°C |
| Zero Gate Voltage Drain Current<br>($V_{DS}$ = 20 $V_{dc}$, $V_{GS}$ = 0 $V_{dc}$)<br>($V_{DS}$ = 20 $V_{dc}$, $V_{GS}$ = 0 $V_{dc}$, $T_J$ = 125°C) | | $I_{DSS}$ | <br>–<br>– | <br>–<br>– | <br>1.5<br>10 | $\mu A_{dc}$ |
| Gate−Body Leakage Current<br>($V_{GS}$ = ±20 $V_{dc}$, $V_{DS}$ = 0 $V_{dc}$) | | $I_{GSS}$ | <br>– | <br>– | <br>±100 | $nA_{dc}$ |
| **ON CHARACTERISTICS** (Note 3) | | | | | | |
| Gate Threshold Voltage (Note 3)<br>($V_{DS}$ = $V_{GS}$, $I_D$ = 250 $\mu A_{dc}$)<br>Threshold Temperature Coefficient (Negative) | | $V_{GS(th)}$ | <br>1.0<br>– | <br>1.5<br>5.0 | <br>2.0<br>– | $V_{dc}$<br><br>mV/°C |
| Static Drain−to−Source On−Resistance (Note 3)<br>($V_{GS}$ = 10 $V_{dc}$, $I_D$ = 110 $A_{dc}$)<br>($V_{GS}$ = 4.5 $V_{dc}$, $I_D$ = 55 $A_{dc}$)<br>($V_{GS}$ = 10 $V_{dc}$, $I_D$ = 20 $A_{dc}$)<br>($V_{GS}$ = 4.5 $V_{dc}$, $I_D$ = 20 $A_{dc}$) | | $R_{DS(on)}$ | <br>–<br>–<br>–<br>– | <br>3.7<br>4.9<br>3.7<br>4.7 | <br>–<br>–<br>4.6<br>6.2 | mΩ |
| Forward Transconductance (Note 3)<br>($V_{DS}$ = 10 $V_{dc}$, $I_D$ = 15 $A_{dc}$) | | $g_{FS}$ | <br>– | <br>44 | <br>– | Mhos |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| Input Capacitance | ($V_{DS}$ = 20 $V_{dc}$, $V_{GS}$ = 0 V, f = 1 MHz) | $C_{iss}$ | – | 2710 | 3440 | pF |
| Output Capacitance | | $C_{oss}$ | – | 1105 | 1670 | |
| Transfer Capacitance | | $C_{rss}$ | – | 227 | 640 | |
| **SWITCHING CHARACTERISTICS** (Note 4) | | | | | | |
| Turn−On Delay Time | ($V_{GS}$ = 10 $V_{dc}$, $V_{DD}$ = 10 $V_{dc}$, $I_D$ = 40 $A_{dc}$, $R_G$ = 3 Ω) | $t_{d(on)}$ | – | 11 | 22 | ns |
| Rise Time | | $t_r$ | – | 39 | 80 | |
| Turn−Off Delay Time | | $t_{d(off)}$ | – | 27 | 40 | |
| Fall Time | | tf | – | 21 | 40 | |
| Gate Charge | ($V_{GS}$ = 4.5 $V_{dc}$, $I_D$ = 40 $A_{dc}$, $V_{DS}$ = 10 $V_{dc}$) (Note 3) | $Q_T$ | – | 23.6 | 28 | nC |
| | | $Q_1$ | – | 5.1 | – | |
| | | $Q_2$ | – | 11 | – | |
| **SOURCE−DRAIN DIODE CHARACTERISTICS** | | | | | | |
| Forward On−Voltage | ($I_S$ = 20 $A_{dc}$, $V_{GS}$ = 0 $V_{dc}$) (Note 3)<br>($I_S$ = 55 $A_{dc}$, $V_{GS}$ = 0 $V_{dc}$)<br>($I_S$ = 20 $A_{dc}$, $V_{GS}$ = 0 $V_{dc}$, $T_J$ = 125°C) | $V_{SD}$ | <br>–<br>– | <br>0.82<br>0.99<br>0.65 | <br>1.2<br>–<br>– | $V_{dc}$ |
| Reverse Recovery Time | ($I_S$ = 30 $A_{dc}$, $V_{GS}$ = 0 $V_{dc}$, $dI_S/dt$ = 100 A/μs) (Note 3) | $t_{rr}$ | – | 36.5 | – | ns |
| | | $t_a$ | – | 17.7 | – | |
| | | $t_b$ | – | 18.8 | – | |
| Reverse Recovery Stored Charge | | $Q_{RR}$ | – | 0.024 | – | μC |

3. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
4. Switching characteristics are independent of operating junction temperatures.

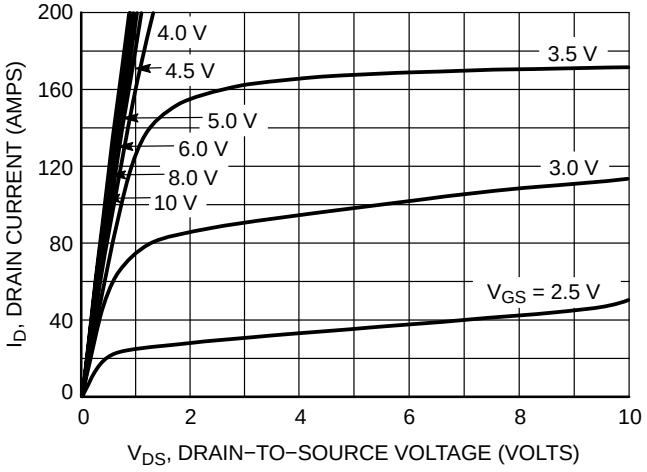



**Figure 1. On−Region Characteristics**

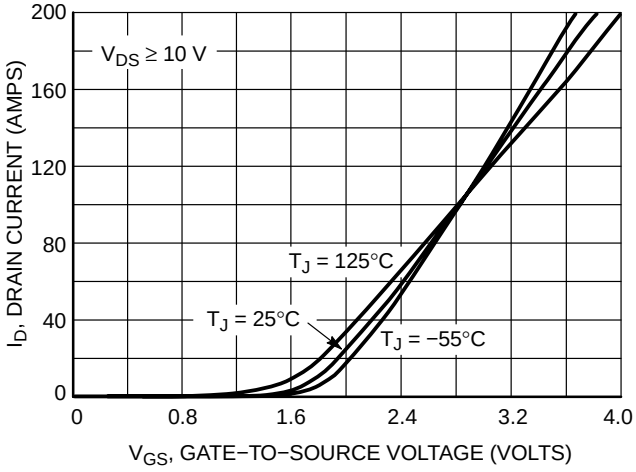



**Figure 2. Transfer Characteristics**

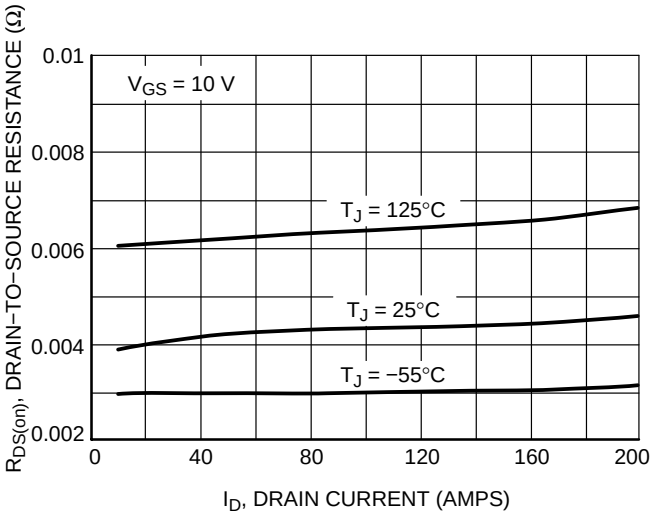



**Figure 3. On−Resistance versus Drain Current and Temperature**

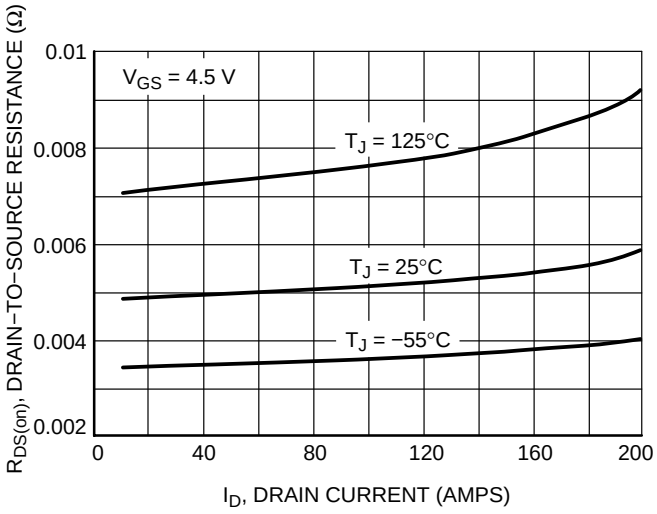



**Figure 4. On−Resistance versus Drain Current and Temperature**

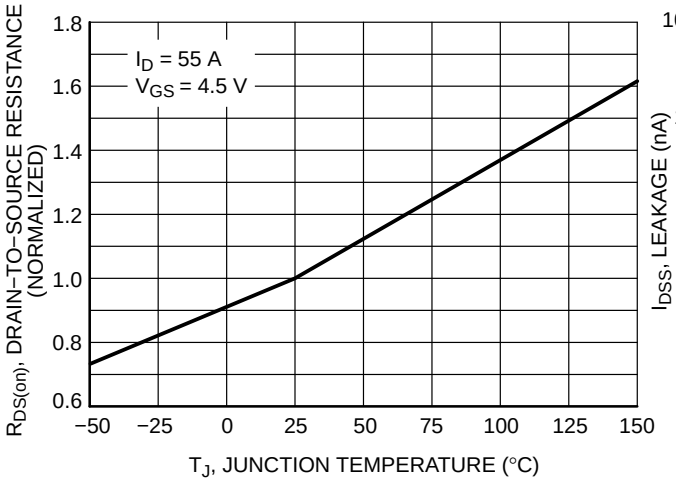



**Figure 5. On−Resistance Variation with Temperature**

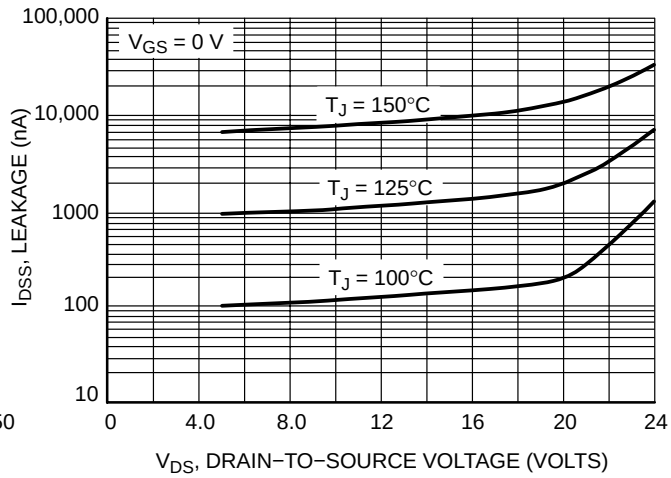



**Figure 6. Drain−to−Source Leakage Current versus Voltage**

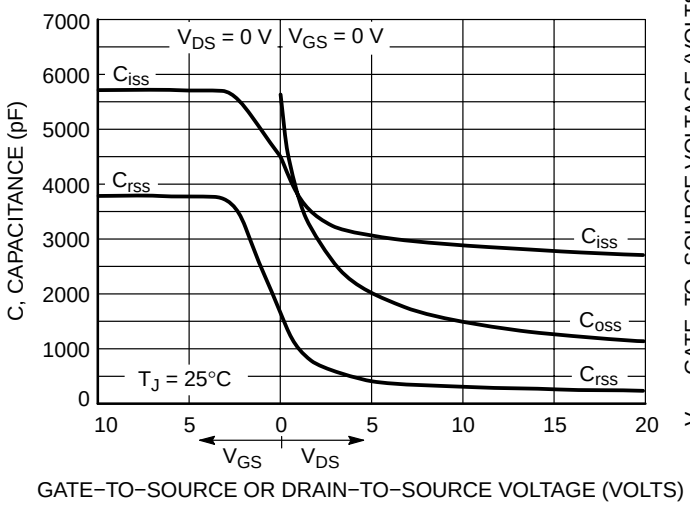



**Figure 7. Capacitance Variation**

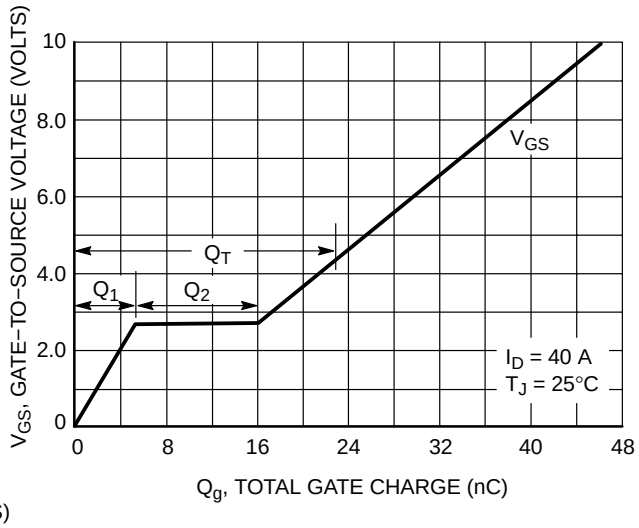



**Figure 8. Gate−to−Source and Drain−to−Source Voltage versus Total Charge**

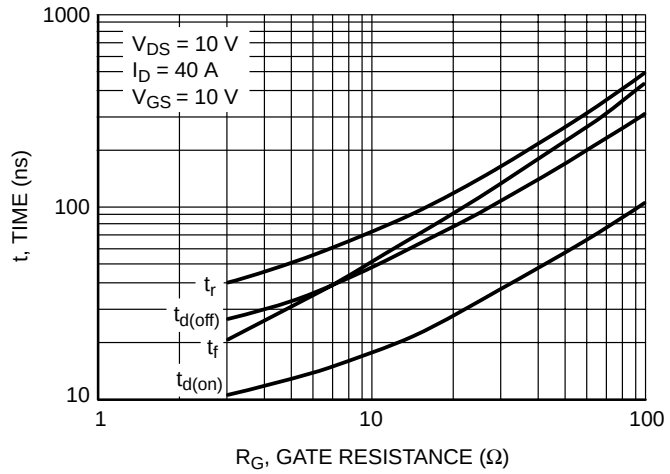



**Figure 9. Resistive Switching Time Variation versus Gate Resistance**

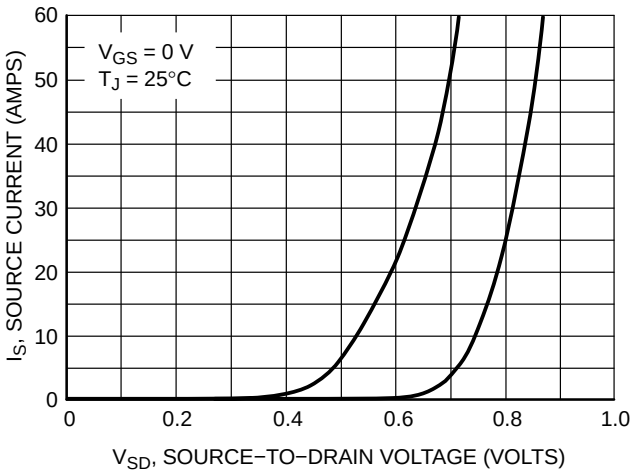



**Figure 10. Diode Forward Voltage versus Current**

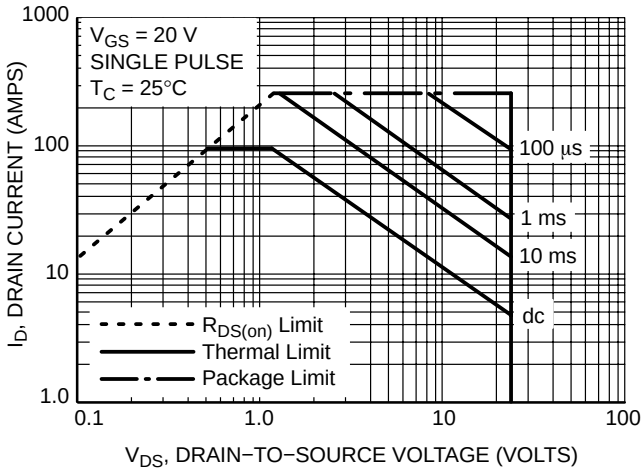



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

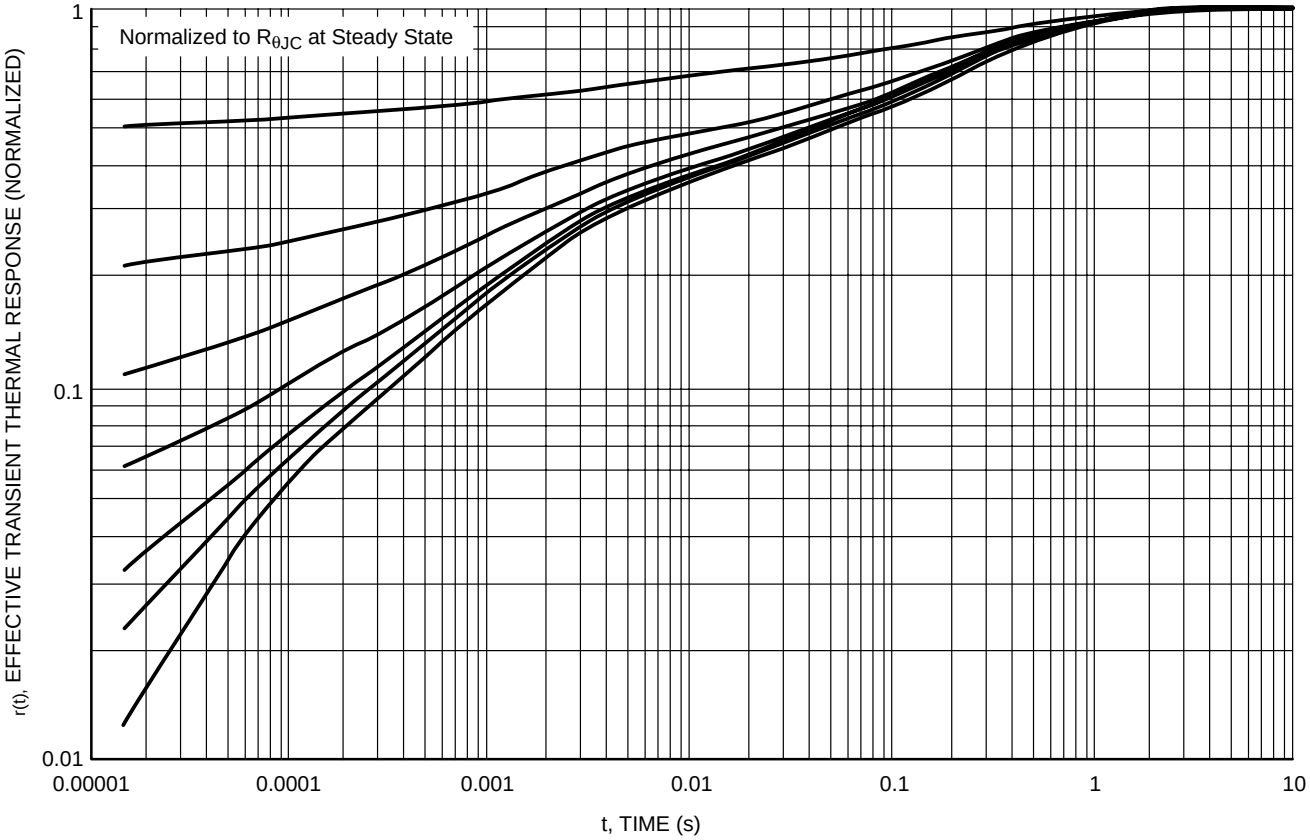
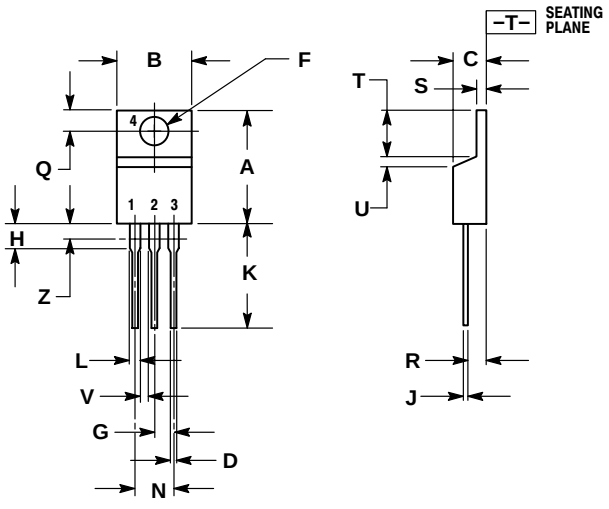



**Figure 12. Thermal Response**

## PACKAGE DIMENSIONS

**TO−220AB**
CASE 221A−09
ISSUE AA



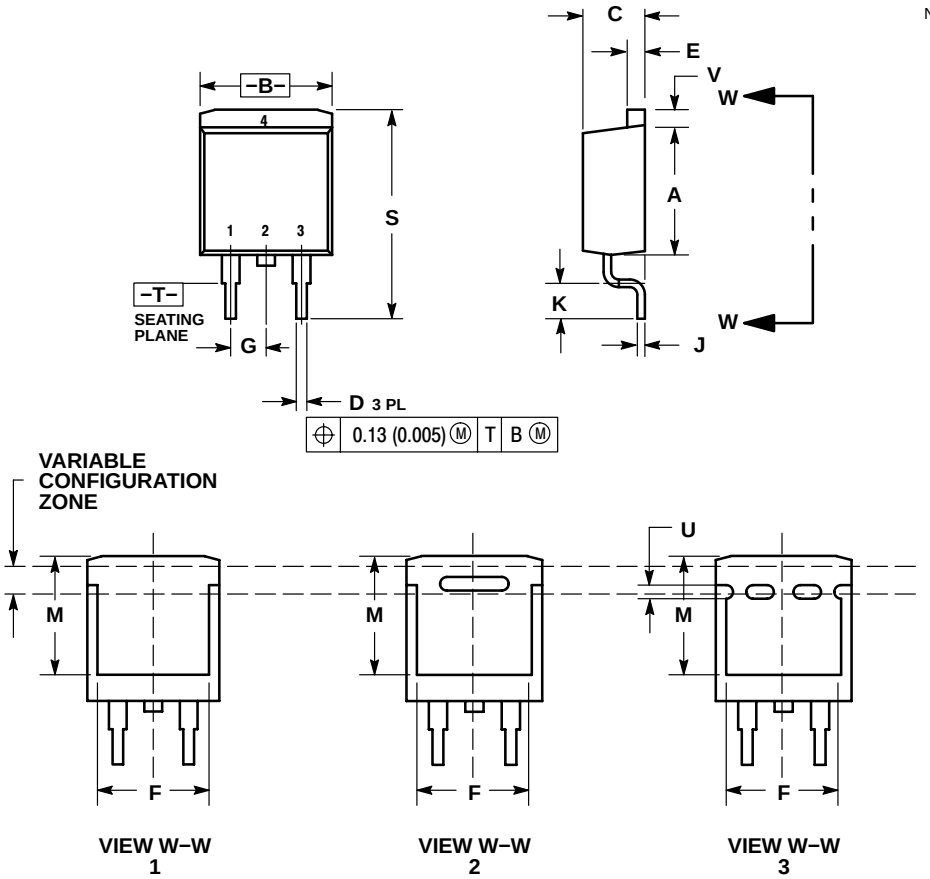

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.570 | 0.620 | 14.48 | 15.75 |
| B | 0.380 | 0.405 | 9.66 | 10.28 |
| C | 0.160 | 0.190 | 4.07 | 4.82 |
| D | 0.025 | 0.035 | 0.64 | 0.88 |
| F | 0.142 | 0.147 | 3.61 | 3.73 |
| G | 0.095 | 0.105 | 2.42 | 2.66 |
| H | 0.110 | 0.155 | 2.80 | 3.93 |
| J | 0.018 | 0.025 | 0.46 | 0.64 |
| K | 0.500 | 0.562 | 12.70 | 14.27 |
| L | 0.045 | 0.060 | 1.15 | 1.52 |
| N | 0.190 | 0.210 | 4.83 | 5.33 |
| Q | 0.100 | 0.120 | 2.54 | 3.04 |
| R | 0.080 | 0.110 | 2.04 | 2.79 |
| S | 0.045 | 0.055 | 1.15 | 1.39 |
| T | 0.235 | 0.255 | 5.97 | 6.47 |
| U | 0.000 | 0.050 | 0.00 | 1.27 |
| V | 0.045 | --- | 1.15 | --- |
| Z | --- | 0.080 | --- | 2.04 |

STYLE 5:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

## PACKAGE DIMENSIONS

**D²PAK**
CASE 418AA−01
ISSUE O




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

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.340 | 0.380 | 8.64 | 9.65 |
| B | 0.380 | 0.405 | 9.65 | 10.29 |
| C | 0.160 | 0.190 | 4.06 | 4.83 |
| D | 0.020 | 0.036 | 0.51 | 0.92 |
| E | 0.045 | 0.055 | 1.14 | 1.40 |
| F | 0.310 | −−− | 7.87 | −−− |
| G | 0.100 BSC | | 2.54 BSC | |
| J | 0.018 | 0.025 | 0.46 | 0.64 |
| K | 0.090 | 0.110 | 2.29 | 2.79 |
| M | 0.280 | −−− | 7.11 | −−− |
| S | 0.575 | 0.625 | 14.60 | 15.88 |
| V | 0.045 | 0.055 | 1.14 | 1.40 |

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




VIEW W−W 1 | VIEW W−W 2 | VIEW W−W 3



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**NTB125N02R/D**