# NTP45N06, NTB45N06

## Power MOSFET
## 45 Amps, 60 Volts
### N–Channel TO–220 and D$^2$PAK

Designed for low voltage, high speed switching applications in power supplies, converters and power motor controls and bridge circuits.

**Features**

- Higher Current Rating
- Lower $R_{DS(on)}$
- Lower $V_{DS(on)}$
- Lower Capacitances
- Lower Total Gate Charge
- Tighter $V_{SD}$ Specification
- Lower Diode Reverse Recovery Time
- Lower Reverse Recovery Stored Charge

**Typical Applications**

- Power Supplies
- Converters
- Power Motor Controls
- Bridge Circuits

**MAXIMUM RATINGS** ($T_J$ = 25°C unless otherwise noted)

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Drain–to–Source Voltage | $V_{DSS}$ | 60 | Vdc |
| Drain–to–Gate Voltage ($R_{GS}$ = 10 MΩ) | $V_{DGR}$ | 60 | Vdc |
| Gate–to–Source Voltage<br>– Continuous<br>– Non–Repetitive ($t_p \le 10$ ms) | <br>$V_{GS}$<br>$V_{GS}$ | <br>±20<br>±30 | Vdc |
| Drain Current<br>– Continuous @ $T_A$ = 25°C<br>– Continuous @ $T_A$ = 100°C<br>– Single Pulse ($t_p \le 10$ μs) | <br>$I_D$<br>$I_D$<br>$I_{DM}$ | <br>45<br>30<br>150 | <br>Adc<br><br>Apk |
| Total Power Dissipation @ $T_A$ = 25°C<br>Derate above 25°C<br>Total Power Dissipation @ $T_A$ = 25°C (Note 1.)<br>Total Power Dissipation @ $T_A$ = 25°C (Note 2.) | $P_D$ | 125<br>0.83<br>3.2<br>2.4 | W<br>W/°C<br>W<br>W |
| Operating and Storage Temperature Range | $T_J$, $T_{stg}$ | –55 to +175 | °C |
| Single Pulse Drain–to–Source Avalanche Energy – Starting $T_J$ = 25°C ($V_{DD}$ = 50 Vdc, $V_{GS}$ = 10 Vdc, RG = 25 Ω, $I_{L(pk)}$ = 40 A, L = 0.3 mH, $V_{DS}$ = 60 Vdc) | $E_{AS}$ | 240 | mJ |

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

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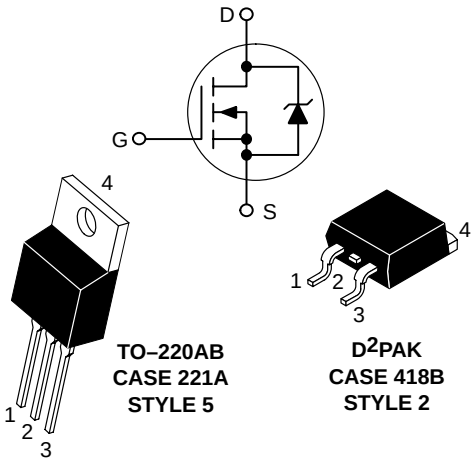
**45 AMPERES**
**60 VOLTS**
**$R_{DS(on)}$ = 26 mΩ**

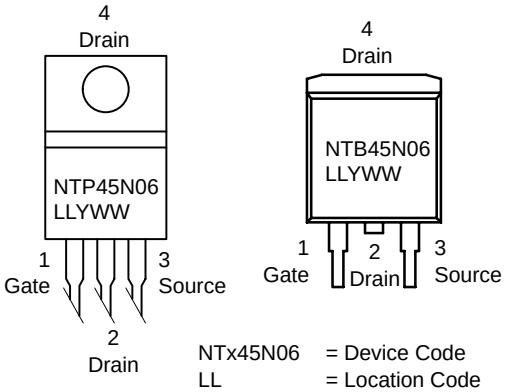
**N–Channel**




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

**D$^2$PAK**
**CASE 418B**
**STYLE 2**

**MARKING DIAGRAMS & PIN ASSIGNMENTS**




| | |
|---|---|
| NTx45N06 | = Device Code |
| LL | = Location Code |
| Y | = Year |
| WW | = Work Week |

**ORDERING INFORMATION**

| Device | Package | Shipping |
|---|---|---|
| NTP45N06 | TO–220AB | 50 Units/Rail |
| NTB45N06 | D$^2$PAK | 50 Units/Rail |
| NTB45N06T4 | D$^2$PAK | 800/Tape & Reel |

**MAXIMUM RATINGS** ($T_J$ = 25°C unless otherwise noted)

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Thermal Resistance – Junction–to–Case<br>– Junction–to–Ambient (Note 3.)<br>– Junction–to–Ambient (Note 4.) | $R_{\theta JC}$<br>$R_{\theta JA}$<br>$R_{\theta JA}$ | 1.2<br>46.8<br>63.2 | °C/W |
| Maximum Lead Temperature for Soldering Purposes, 1/8″ from case for 10 seconds | $T_L$ | 260 | °C |

**ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Drain–to–Source Breakdown Voltage (Note 5.)<br>($V_{GS}$ = 0 Vdc, $I_D$ = 250 μAdc)<br>Temperature Coefficient (Positive) | $V_{(BR)DSS}$ | <br>60<br>– | <br>70<br>57 | <br>–<br>– | Vdc<br><br>mV/°C |
| Zero Gate Voltage Drain Current<br>($V_{DS}$ = 60 Vdc, $V_{GS}$ = 0 Vdc)<br>($V_{DS}$ = 60 Vdc, $V_{GS}$ = 0 Vdc, $T_J$ = 150°C) | $I_{DSS}$ | <br>–<br>– | <br>–<br>– | <br>1.0<br>10 | μAdc |
| Gate–Body Leakage Current ($V_{GS}$ = ±20 Vdc, $V_{DS}$ = 0 Vdc) | $I_{GSS}$ | – | – | ±100 | nAdc |
| **ON CHARACTERISTICS** (Note 5.) | | | | | |
| Gate Threshold Voltage (Note 5.)<br>($V_{DS}$ = $V_{GS}$, $I_D$ = 250 μAdc)<br>Threshold Temperature Coefficient (Negative) | $V_{GS(th)}$ | <br>2.0<br>– | <br>2.8<br>7.2 | <br>4.0<br>– | Vdc<br>mV/°C |
| Static Drain–to–Source On–Resistance (Note 5.)<br>($V_{GS}$ = 10 Vdc, $I_D$ = 22.5 Adc) | $R_{DS(on)}$ | <br>– | <br>21 | <br>26 | mOhm |
| Static Drain–to–Source On–Voltage (Note 5.)<br>($V_{GS}$ = 10 Vdc, $I_D$ = 45 Adc)<br>($V_{GS}$ = 10 Vdc, $I_D$ = 22.5 Adc, $T_J$ = 150°C) | $V_{DS(on)}$ | <br>–<br>– | <br>0.93<br>0.93 | <br>1.4<br>– | Vdc |
| Forward Transconductance (Note 5.) ($V_{DS}$ = 8.0 Vdc, $I_D$ = 12 Adc) | $g_{FS}$ | – | 16.6 | – | mhos |
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Input Capacitance | ($V_{DS}$ = 25 Vdc, $V_{GS}$ = 0 Vdc, f = 1.0 MHz) | $C_{iss}$ | – | 1224 | 1725 | pF |
| Output Capacitance | | $C_{oss}$ | – | 345 | 485 | |
| Transfer Capacitance | | $C_{rss}$ | – | 76 | 160 | |
| **SWITCHING CHARACTERISTICS** (Note 6.) | | | | | | |
| Turn–On Delay Time | ($V_{DD}$ = 30 Vdc, $I_D$ = 45 Adc, $V_{GS}$ = 10 Vdc, $R_G$ = 9.1 Ω) (Note 5.) | $t_{d(on)}$ | – | 10 | 25 | ns |
| Rise Time | | $t_r$ | – | 101 | 200 | |
| Turn–Off Delay Time | | $t_{d(off)}$ | – | 33 | 70 | |
| Fall Time | | $t_f$ | – | 106 | 220 | |
| Gate Charge | ($V_{DS}$ = 48 Vdc, $I_D$ = 45 Adc, $V_{GS}$ = 10 Vdc) (Note 5.) | $Q_T$ | – | 33 | 46 | nC |
| | | $Q_1$ | – | 6.4 | – | |
| | | $Q_2$ | – | 15 | – | |
| **SOURCE–DRAIN DIODE CHARACTERISTICS** | | | | | | |
| Forward On–Voltage | ($I_S$ = 45 Adc, $V_{GS}$ = 0 Vdc) (Note 5.)<br>($I_S$ = 45 Adc, $V_{GS}$ = 0 Vdc, $T_J$ = 150°C) | $V_{SD}$ | <br>– | <br>1.08<br>0.93 | <br>1.2<br>– | Vdc |
| Reverse Recovery Time | ($I_S$ = 45 Adc, $V_{GS}$ = 0 Vdc, $dI_S/dt$ = 100 A/μs) (Note 5.) | $t_{rr}$ | – | 53.1 | – | ns |
| | | $t_a$ | – | 36 | – | |
| | | $t_b$ | – | 16.9 | – | |
| Reverse Recovery Stored Charge | | $Q_{RR}$ | – | 0.087 | – | μC |

3. When surface mounted to an FR4 board using 1″ pad size, (Cu Area 1.127 $in^2$).
4. When surface mounted to an FR4 board using the minimum recommended pad size, (Cu Area 0.412 $in^2$).
5. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
6. Switching characteristics are independent of operating junction temperatures.

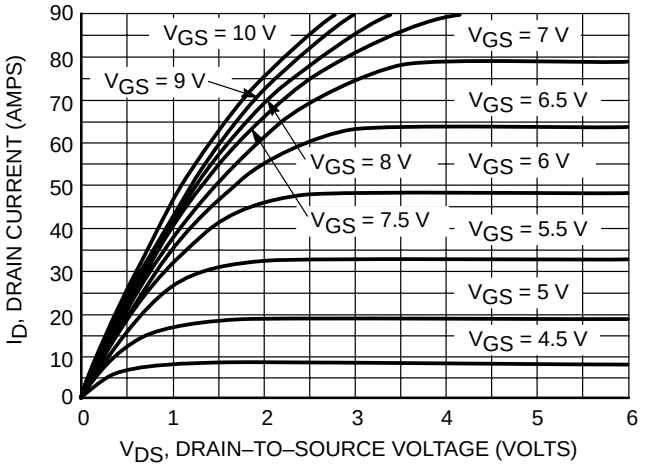



**Figure 1. On–Region Characteristics**

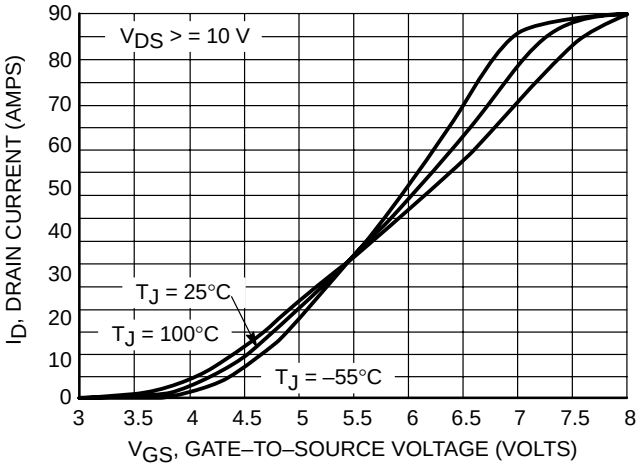



**Figure 2. Transfer Characteristics**

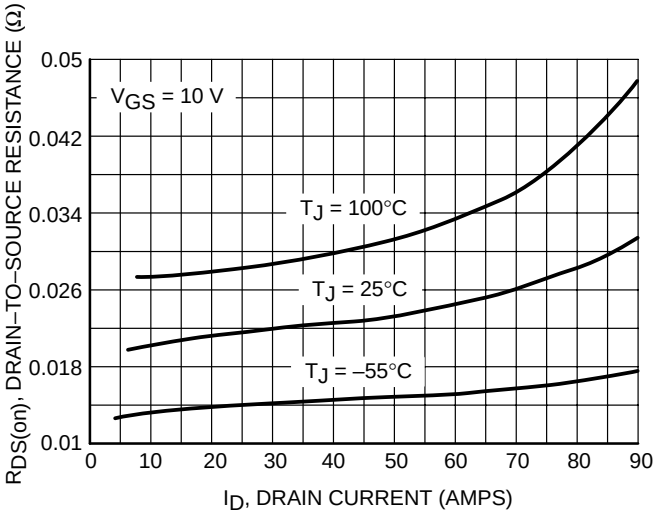



**Figure 3. On–Resistance vs. Gate–to–Source Voltage**

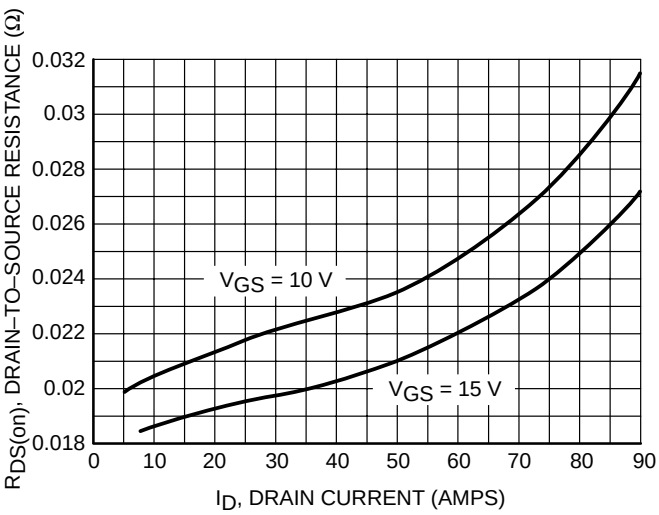



**Figure 4. On–Resistance vs. Drain Current and Gate Voltage**

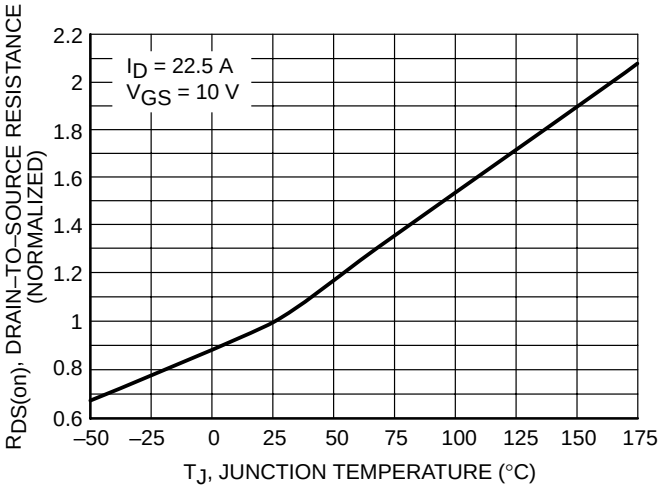



**Figure 5. On–Resistance Variation with Temperature**

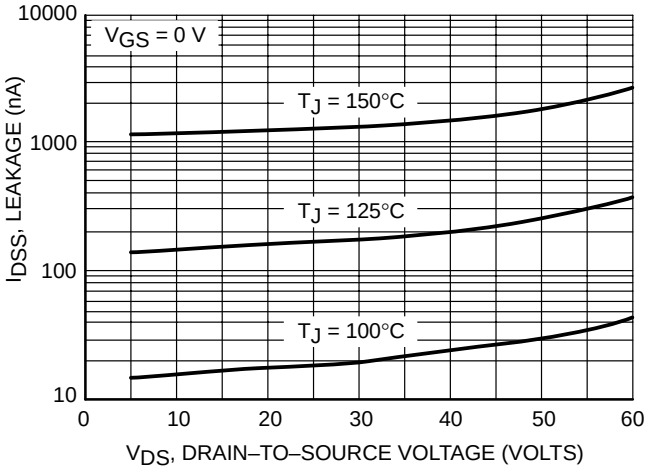



**Figure 6. Drain–to–Source Leakage Current vs. Voltage**

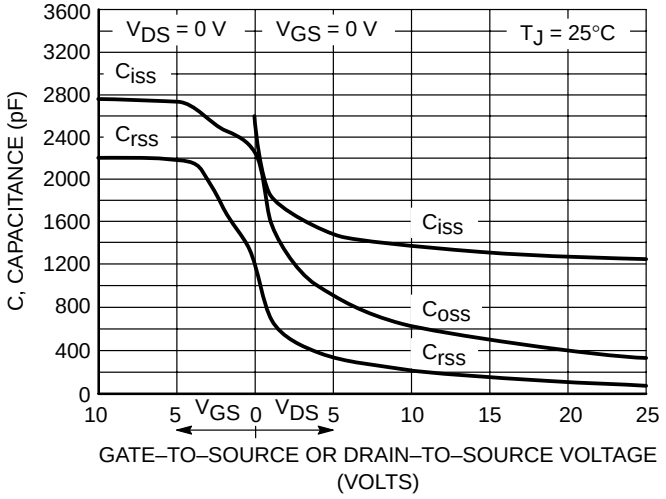



**Figure 7. Capacitance Variation**

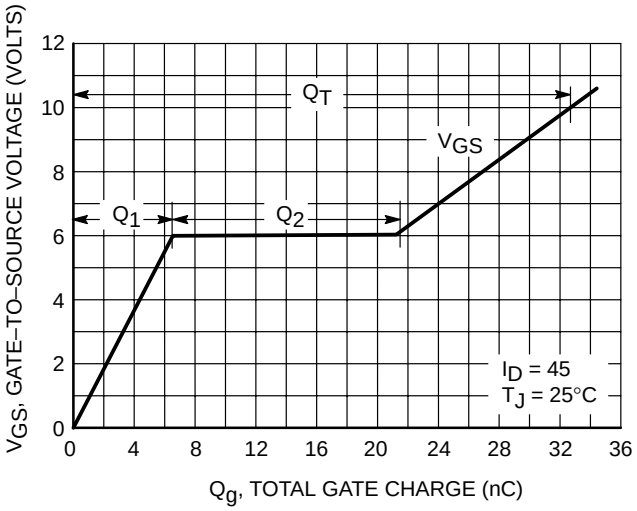



**Figure 8. Gate–to–Source and Drain–to–Source Voltage vs. Total Charge**

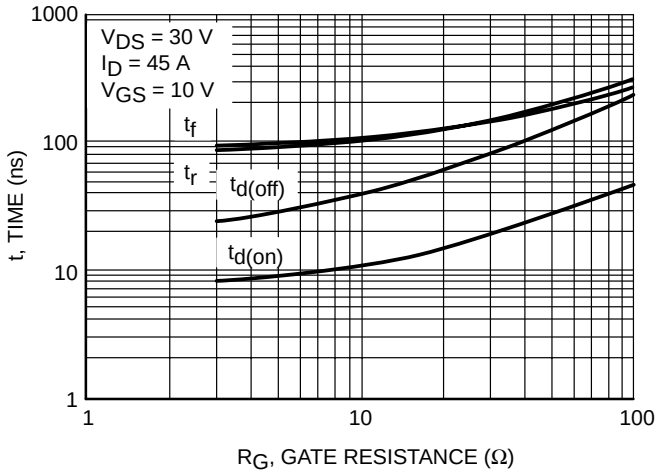



**Figure 9. Resistive Switching Time Variation vs. Gate Resistance**

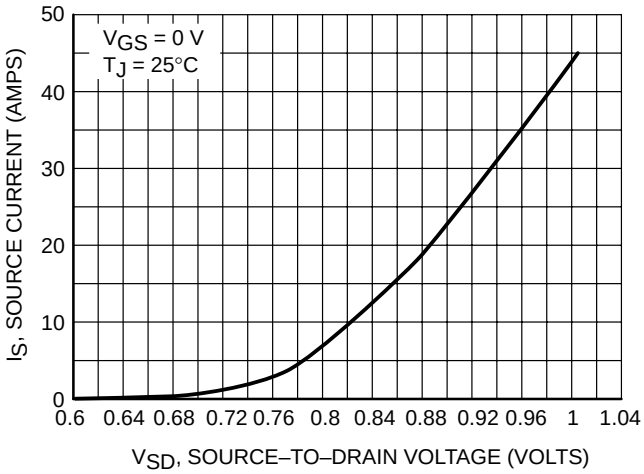



**Figure 10. Diode Forward Voltage vs. Current**

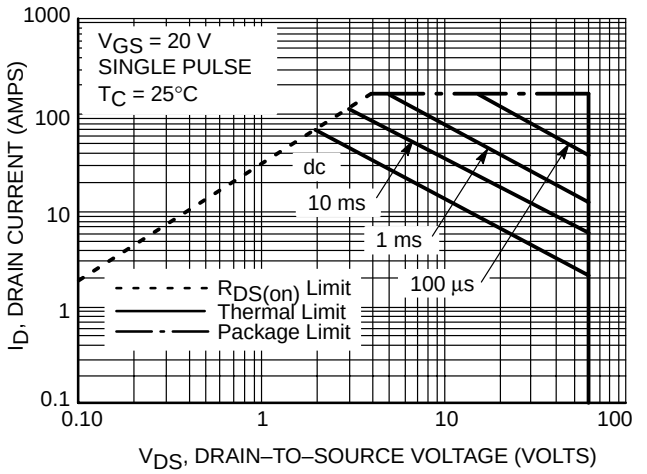



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

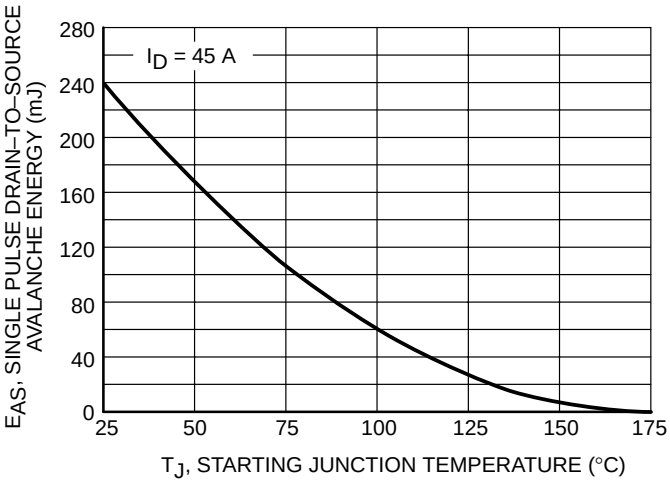



**Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature**

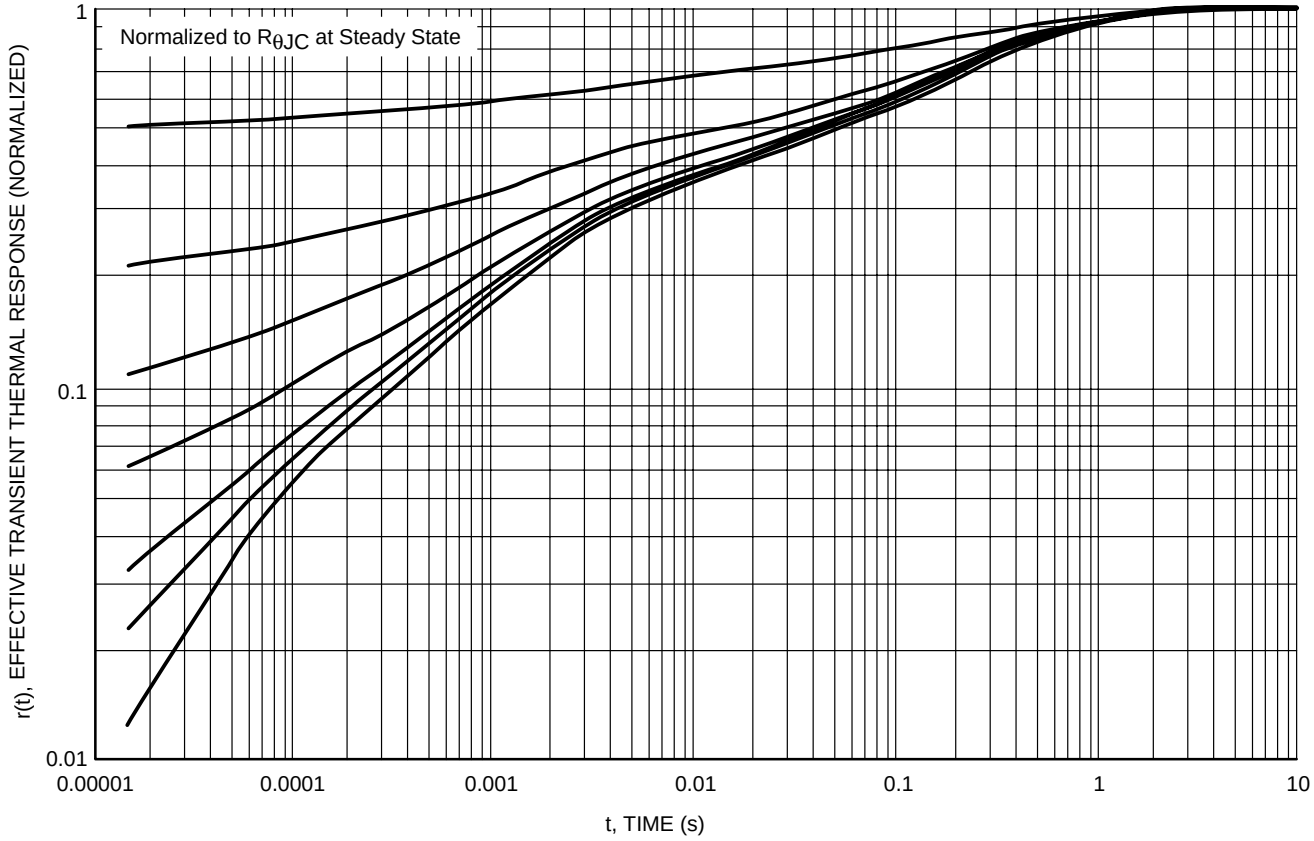



**Figure 13. Thermal Response**

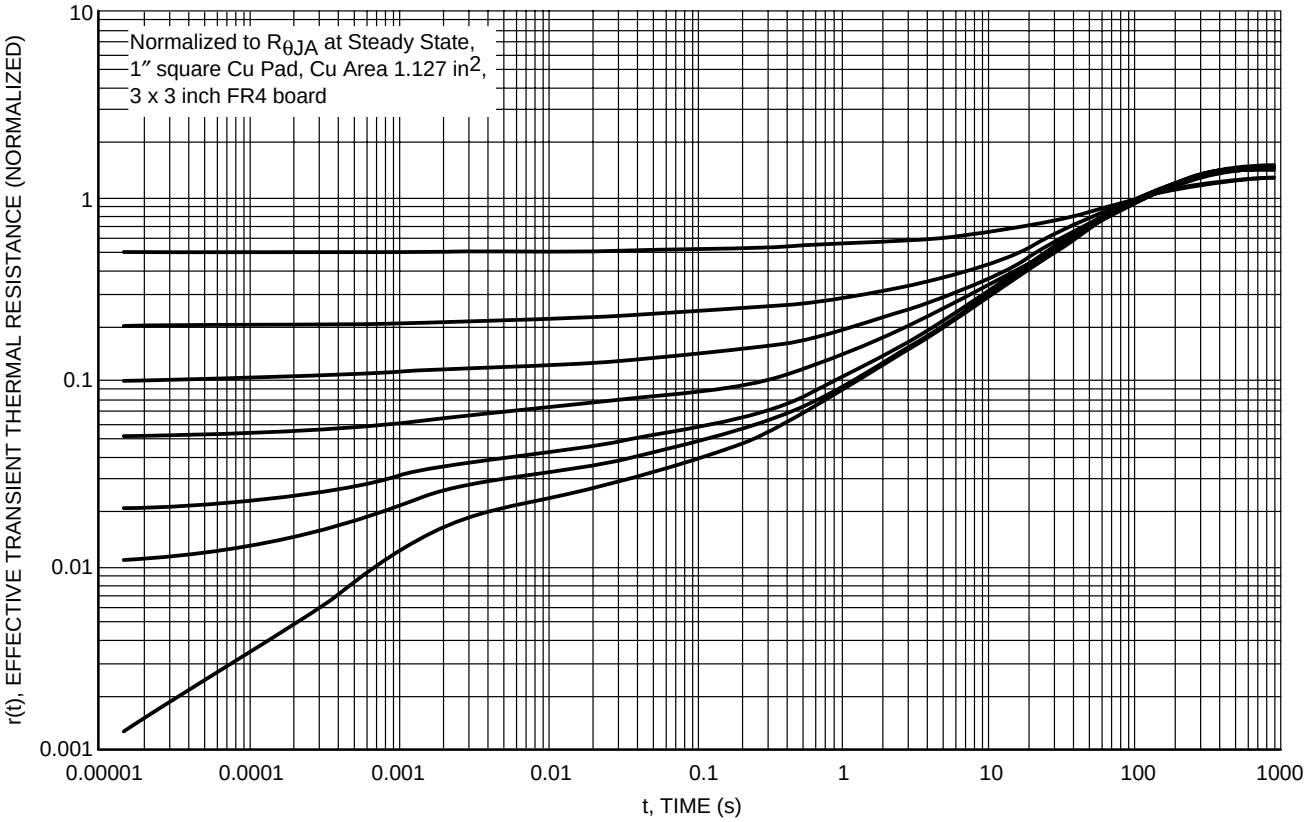
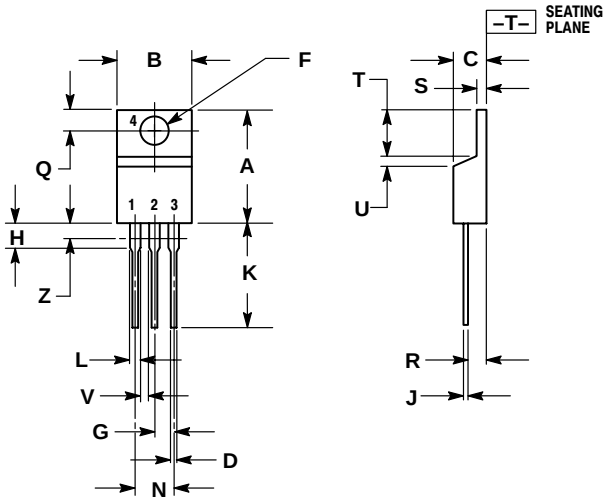



**Figure 14. Thermal Response**

## PACKAGE DIMENSIONS

**TO–220 THREE–LEAD**
**TO–220AB**
CASE 221A–09
ISSUE AA



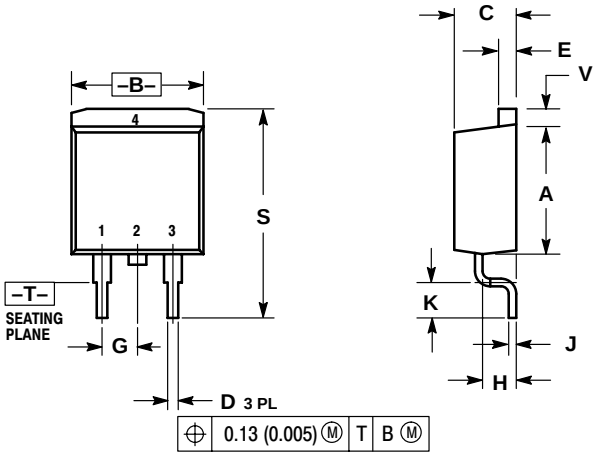

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

| | 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 418B–03
ISSUE D




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 | 0.035 | 0.51 | 0.89 |
| E | 0.045 | 0.055 | 1.14 | 1.40 |
| G | 0.100 BSC | | 2.54 BSC | |
| H | 0.080 | 0.110 | 2.03 | 2.79 |
| J | 0.018 | 0.025 | 0.46 | 0.64 |
| K | 0.090 | 0.110 | 2.29 | 2.79 |
| 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

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