

# NTP6N50

## Preferred Devices

### Product Preview Power MOSFET 6 Amps, 500 Volts N-Channel TO-220

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

#### Features

- Higher Current Rating
- Lower  $R_{DS(on)}$
- Lower Capacitances
- Lower Total Gate Charge
- Tighter V<sub>SD</sub> Specifications
- Avalanche Energy Specified

#### Typical Applications

- Switch Mode Power Supplies
- PWM Motor Controls
- Converters
- Bridge Circuits

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

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	500	Vdc
Drain-Gate Voltage ( $R_{GS} = 1.0 \text{ M}\Omega$ )	$V_{DGR}$	500	Vdc
Gate-Source Voltage – Continuous – Non-Repetitive ( $t_p \leq 10 \text{ ms}$ )	$V_{GS}$ $V_{GS}$	$\pm 20$ $\pm 40$	Vdc
Drain – Continuous @ $T_A = 25^\circ\text{C}$ – Continuous @ $T_A = 100^\circ\text{C}$ – Single Pulse ( $t_p \leq 10 \mu\text{s}$ )	$I_D$ $I_D$ $I_{DM}$	6.0 5.0 18	Adc Apk
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$ Total Power Dissipation @ $T_A = 25^\circ\text{C}$ (Note 1.)	$PD$	104 0.83 1.75	Watts W/ $^\circ\text{C}$ Watts
Operating and Storage Temperature Range	$T_J, T_{Stg}$	-55 to +150	$^\circ\text{C}$
Single Drain-to-Source Avalanche Energy – Starting $T_J = 25^\circ\text{C}$ ( $V_{DD} = 100 \text{ V}$ , $V_{GS} = 10 \text{ Vdc}$ , $I_L(\text{pk}) = 6 \text{ A}$ , $L = 10 \text{ mH}$ , $V_{DS} = 500 \text{ Vdc}$ , $R_G = 25 \Omega$ )	$E_{AS}$	180	mJ
Thermal Resistance – Junction-to-Case – Junction-to-Ambient	$R_{\theta JC}$ $R_{\theta JA}$	1.2 62.5	$^\circ\text{C/W}$
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	$T_L$	260	$^\circ\text{C}$

1. Repetitive rating; pulse width limited by maximum junction temperature.

This document contains information on a product under development. ON Semiconductor reserves the right to change or discontinue this product without notice.

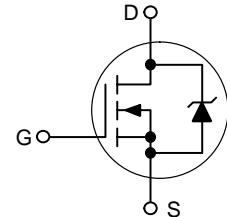


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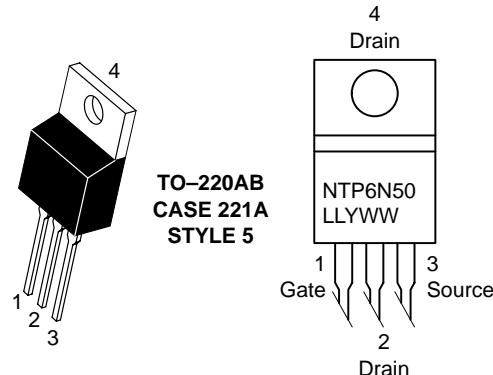
<http://onsemi.com>

**6 AMPERES  
500 VOLTS  
 $R_{DS(on)} = 1700 \text{ m}\Omega$**

**N-Channel**



#### MARKING DIAGRAM & PIN ASSIGNMENT



NTP6N50 = Device Code

LL = Location Code

Y = Year

WW = Work Week

#### ORDERING INFORMATION

Device	Package	Shipping
NTP6N50	TO-220AB	50 Units/Rail

**Preferred** devices are recommended choices for future use and best overall value.

# NTP6N50

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

Characteristic	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage (Note 2.) ( $V_{GS} = 0 \text{ Vdc}$ , $I_D = 250 \mu\text{A}$ ) Temperature Coefficient (Positive)	$V_{(BR)DSS}$	500 —	— 590	— —	Vdc $\text{mV}/^\circ\text{C}$
Zero Gate Voltage Drain Current ( $V_{DS} = 500 \text{ Vdc}$ , $V_{GS} = 0 \text{ Vdc}$ ) ( $V_{DS} = 500 \text{ Vdc}$ , $V_{GS} = 0 \text{ Vdc}$ , $T_J = 125^\circ\text{C}$ )	$I_{DSS}$	— —	— —	10 100	$\mu\text{A}$
Gate-Body Leakage Current ( $V_{GS} = \pm 20 \text{ Vdc}$ , $V_{DS} = 0 \text{ Vdc}$ )	$I_{GSS}$	—	—	$\pm 100$	$\text{nA}$

### ON CHARACTERISTICS (Note 2.)

Gate Threshold Voltage ( $V_{DS} = V_{GS}$ , $I_D = 250 \mu\text{A}$ ) Temperature Coefficient (Negative)	$V_{GS(\text{th})}$	2.0 —	3.1 6.4	4.0 —	Vdc $\text{mV}/^\circ\text{C}$
Static Drain-to-Source On-Resistance ( $V_{GS} = 10 \text{ Vdc}$ , $I_D = 3 \text{ Adc}$ )	$R_{DS(\text{on})}$	—	1300	1700	$\text{m}\Omega$
Static Drain-to-Source On-Resistance ( $V_{GS} = 10 \text{ Vdc}$ , $I_D = 6 \text{ Adc}$ ) ( $V_{GS} = 10 \text{ Vdc}$ , $I_D = 3 \text{ Adc}$ , $T_J = 125^\circ\text{C}$ )	$V_{DS(\text{on})}$	— —	— —	12.2 11.0	V
Forward Transconductance ( $V_{DS} = 15 \text{ Vdc}$ , $I_D = 3 \text{ Adc}$ )	$g_{FS}$	—	6.7	—	$\text{mhos}$

### DYNAMIC CHARACTERISTICS

Input Capacitance	( $V_{DS} = 25 \text{ Vdc}$ , $V_{GS} = 0 \text{ Vdc}$ , $f = 1.0 \text{ MHz}$ )	$C_{iss}$	—	520	730	pF
Output Capacitance		$C_{oss}$	—	170	240	
Transfer Capacitance		$C_{rss}$	—	5.0	20	

### SWITCHING CHARACTERISTICS (Note 3.)

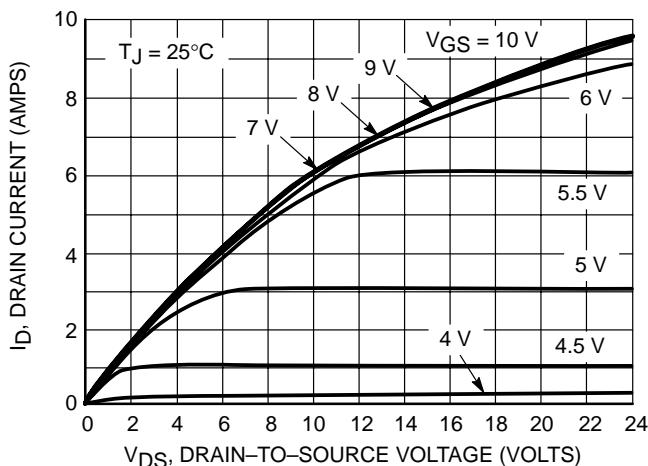
Turn-On Delay Time	( $V_{DD} = 250 \text{ Vdc}$ , $I_D = 6 \text{ Adc}$ , $V_{GS} = 10 \text{ Vdc}$ , $R_G = 9.1 \Omega$ )	$t_{d(\text{on})}$	—	9.0	20	ns
Rise Time		$t_r$	—	12	20	
Turn-Off Delay Time		$t_{d(\text{off})}$	—	17	40	
Fall Time		$t_f$	—	12	30	
Gate Charge	( $V_{DS} = 400 \text{ Vdc}$ , $I_D = 6 \text{ Adc}$ , $V_{GS} = 10 \text{ Vdc}$ )	$Q_T$	—	10	20	nC
		$Q_1$	—	3.0	—	
		$Q_2$	—	6.0	—	

### SOURCE-DRAIN DIODE CHARACTERISTICS

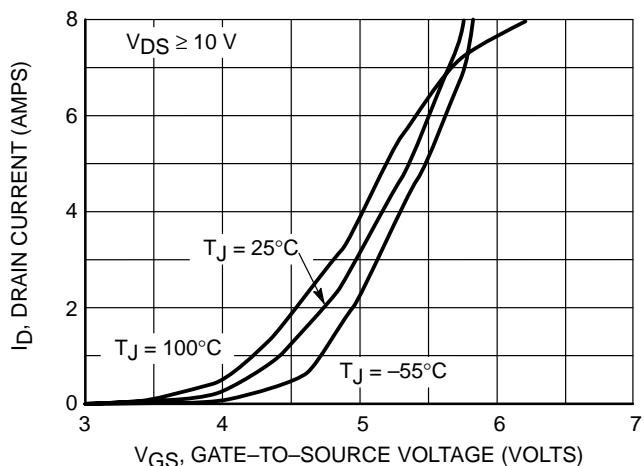
Forward On-Voltage (Note 2.)	( $I_S = 6 \text{ Adc}$ , $V_{GS} = 0 \text{ Vdc}$ ) ( $I_S = 6 \text{ Adc}$ , $V_{GS} = 0 \text{ Vdc}$ , $T_J = 125^\circ\text{C}$ )	$V_{SD}$	— —	0.9 0.8	1.0 —	Vdc
Reverse Recovery Time	( $I_S = 6 \text{ Adc}$ , $V_{GS} = 0 \text{ Vdc}$ , $di_S/dt = 100 \text{ A}/\mu\text{s}$ )	$t_{rr}$	—	251	—	ns
		$t_a$	—	168	—	
		$t_b$	—	83	—	
		$Q_{RR}$	—	2.3	—	
Reverse Recovery Stored Charge						$\mu\text{C}$

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

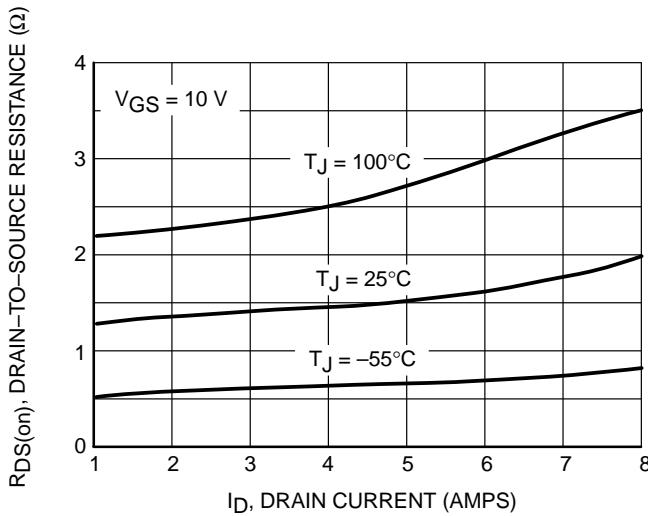
3. Switching characteristics are independent of operating junction temperature.



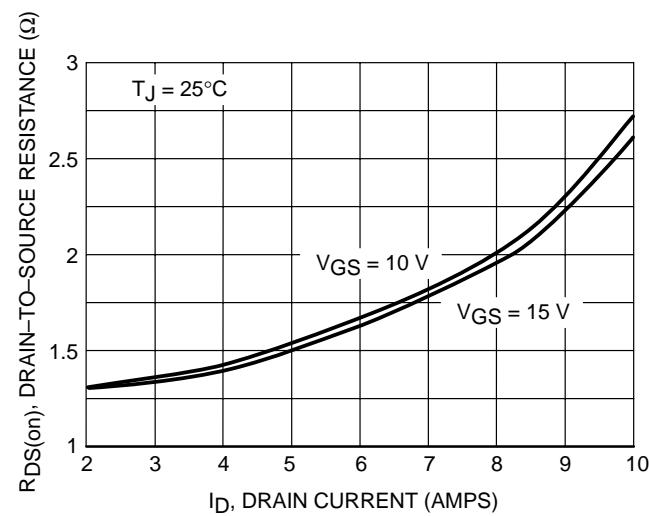
**Figure 1. On-Region Characteristics**



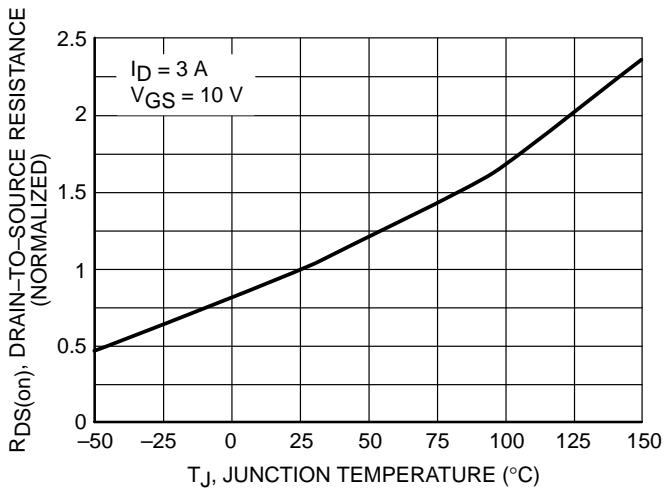
**Figure 2. Transfer Characteristics**



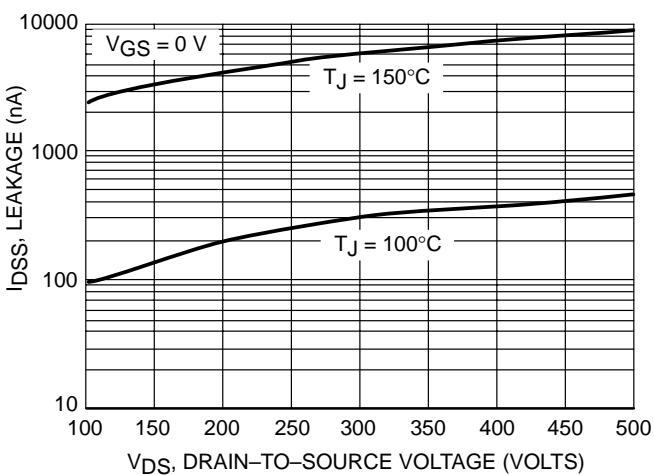
**Figure 3. On-Resistance versus Drain Current and Temperature**



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



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



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

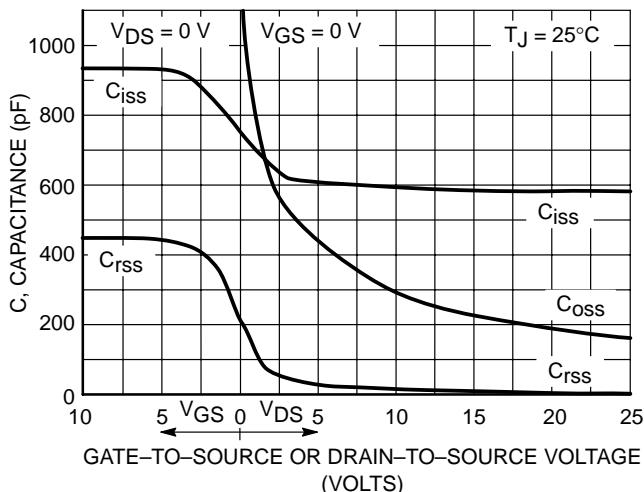


Figure 7. Capacitance Variation

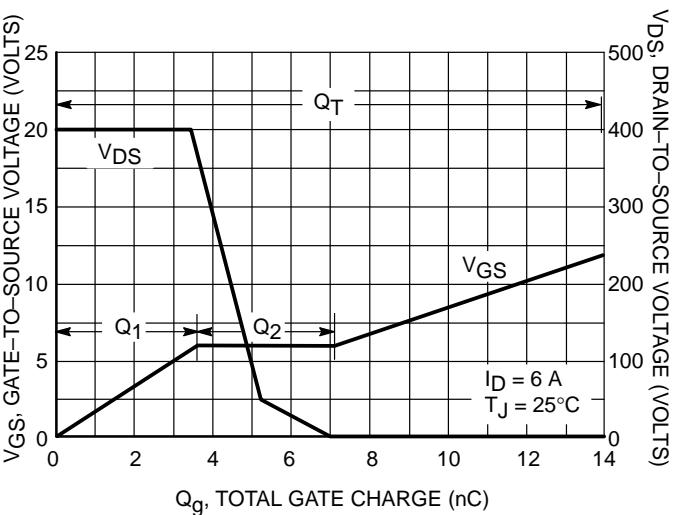


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

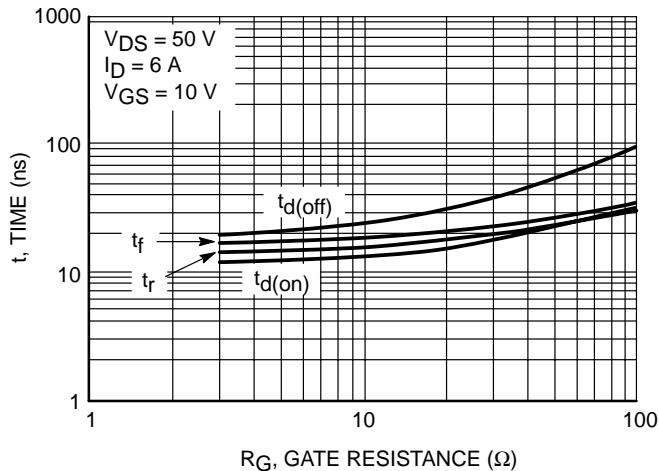


Figure 9. Resistive Switching Time Variation versus Gate Resistance

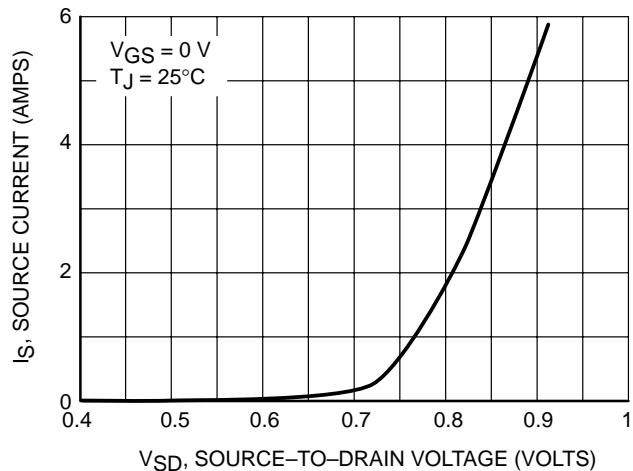


Figure 10. Diode Forward Voltage versus Current

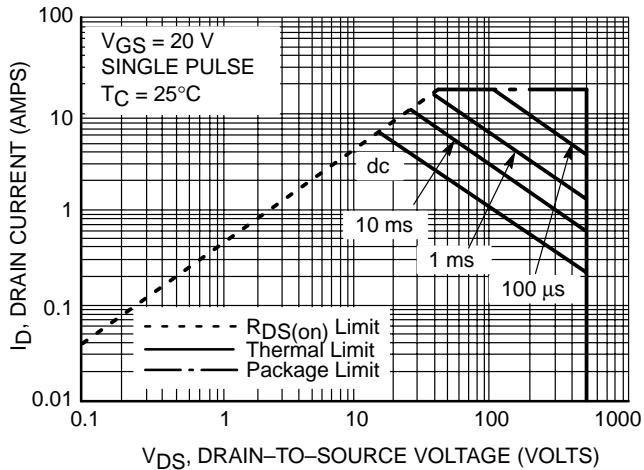


Figure 11. Maximum Rated Forward Biased Safe Operating Area

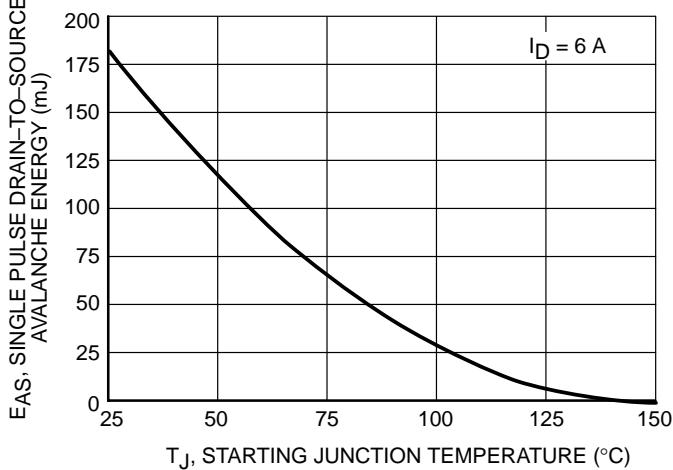
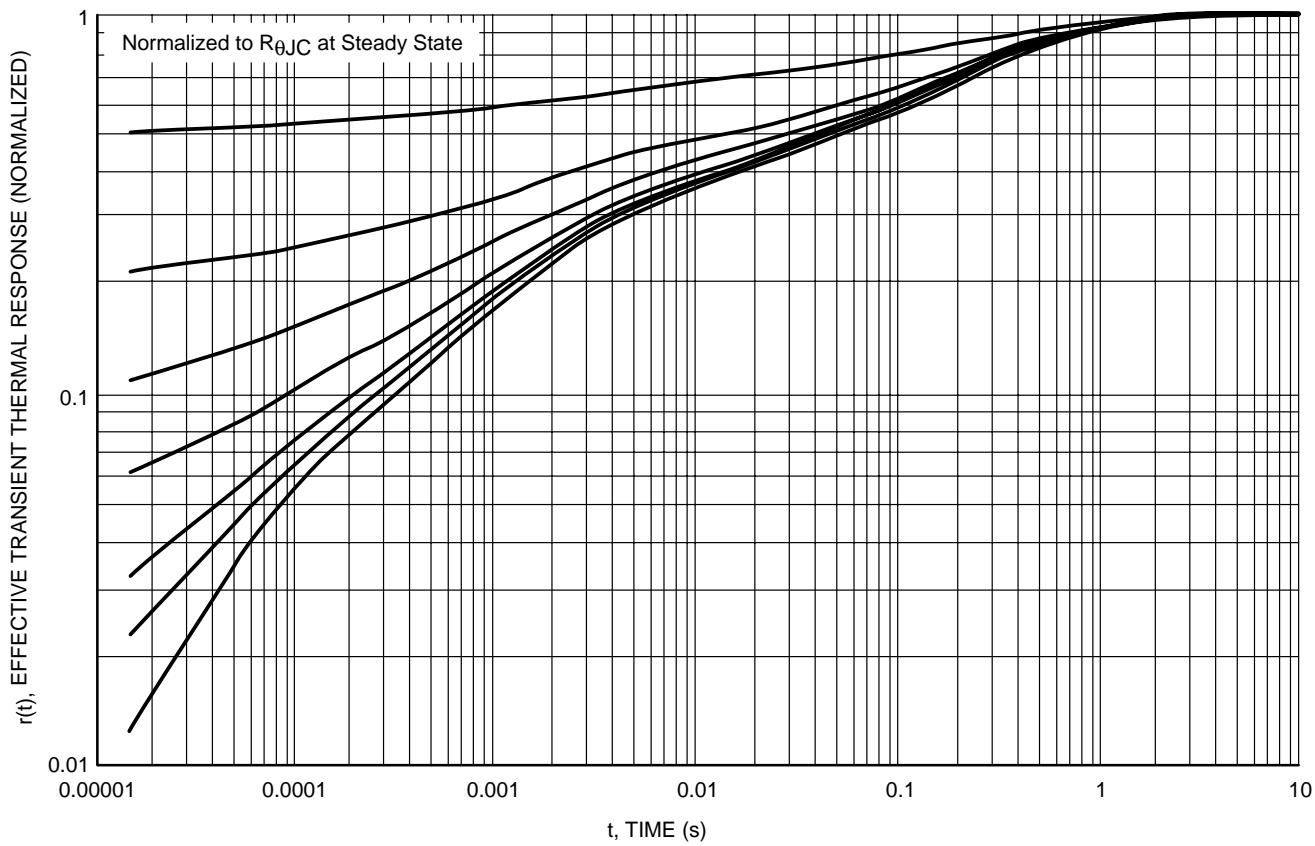


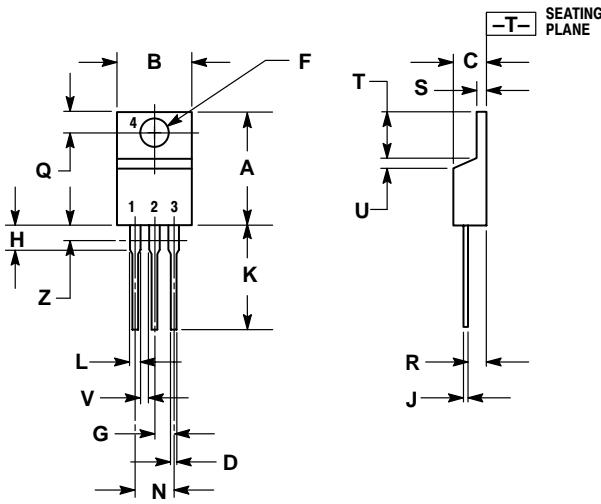
Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature

## NTP6N50



**Figure 13. 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.

DIM	INCHES		MILLIMETERS	
	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:

1. GATE
2. DRAIN

## **Notes**

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