

# 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  $V_{SD}$  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	$V_{GS}$	$\pm 20$	Vdc
- Continuous	$V_{GS}$	$\pm 40$	
- Non-Repetitive ( $t_p \leq 10\text{ ms}$ )			
Drain-Continuous @ $T_A 25^\circ\text{C}$	$I_D$	6.0	Adc
- Continuous @ $T_A 100^\circ\text{C}$	$I_D$	5.0	
- Single Pulse ( $t_p \leq 10\text{ }\mu\text{s}$ )	$I_{DM}$	18	Apk
Total Power Dissipation @ $T_A 25^\circ\text{C}$	$P_D$	104	Watts
Derate above $25^\circ\text{C}$		0.83	W/ $^\circ\text{C}$
Total Power Dissipation @ $T_A 25^\circ\text{C}$ (Note 1.)		1.75	Watts
Operating and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$
Single Drain-to-Source Avalanche Energy - Starting $T_J = 25^\circ\text{C}$ ( $V_{DD} = 100\text{ V}$ , $V_{GS} = 10\text{ Vdc}$ , $I_L(\text{pk}) = 6\text{ A}$ , $L = 10\text{ mH}$ , $V_{DS} = 500\text{ Vdc}$ , $R_G = 25\text{ }\Omega$ )	$E_{AS}$	180	mJ
Thermal Resistance			$^\circ\text{C/W}$
- Junction-to-Case	$R_{\theta JC}$	1.2	
- Junction-to-Ambient	$R_{\theta JA}$	62.5	
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.

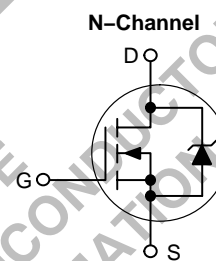
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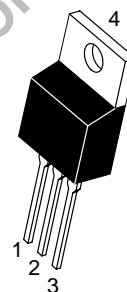
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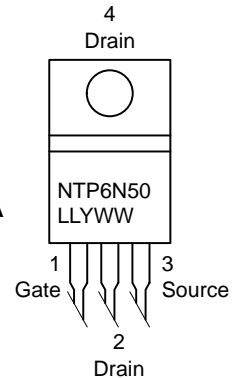
**6 AMPERES**  
**500 VOLTS**  
 $R_{DS(on)} = 1700\text{ m}\Omega$



### MARKING DIAGRAM & PIN ASSIGNMENT



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



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<sub>C</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage (Note 2.) (V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = 250 μAdc) Temperature Coefficient (Positive)	V <sub>(BR)DSS</sub>	500 –	– 590	– –	Vdc mV/°C
Zero Gate Voltage Drain Current (V <sub>DS</sub> = 500 Vdc, V <sub>GS</sub> = 0 Vdc) (V <sub>DS</sub> = 500 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C)	I <sub>DSS</sub>	– –	– –	10 100	μAdc
Gate-Body Leakage Current (V <sub>GS</sub> = ±20 Vdc, V <sub>DS</sub> = 0 Vdc)	I <sub>GSS</sub>	–	–	±100	nAdc

### ON CHARACTERISTICS (Note 2.)

Gate Threshold Voltage (V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μAdc) Temperature Coefficient (Negative)	V <sub>GS(th)</sub>	2.0 –	3.1 6.4	4.0 –	Vdc mV/°C
Static Drain-to-Source On-Resistance (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 3 Adc)	R <sub>DS(on)</sub>	–	1300	1700	mΩ
Static Drain-to-Source On-Resistance (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 6 Adc) (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 3 Adc, T <sub>J</sub> = 125°C)	V <sub>DS(on)</sub>	– –	– –	12.2 11.0	V
Forward Transconductance (V <sub>DS</sub> = 15 Vdc, I <sub>D</sub> = 3 Adc)	g <sub>FS</sub>	–	6.7	–	mhos

### DYNAMIC CHARACTERISTICS

Input Capacitance	(V <sub>DS</sub> = 25 Vdc, V <sub>GS</sub> = 0 Vdc, f = 1.0 MHz)	C <sub>iss</sub>	–	520	730	pF
Output Capacitance		C <sub>oss</sub>	–	170	240	
Transfer Capacitance		C <sub>rss</sub>	–	5.0	20	

### SWITCHING CHARACTERISTICS (Note 3.)

Turn-On Delay Time	(V <sub>DD</sub> = 250 Vdc, I <sub>D</sub> = 6 Adc, V <sub>GS</sub> = 10 Vdc, R <sub>G</sub> = 9.1 Ω)	t <sub>d(on)</sub>	–	9.0	20	ns
Rise Time		t <sub>r</sub>	–	12	20	
Turn-Off Delay Time		t <sub>d(off)</sub>	–	17	40	
Fall Time		t <sub>f</sub>	–	12	30	
Gate Charge	(V <sub>DS</sub> = 400 Vdc, I <sub>D</sub> = 6 Adc, V <sub>GS</sub> = 10 Vdc)	Q <sub>T</sub>	–	10	20	nC
		Q <sub>1</sub>	–	3.0	–	
		Q <sub>2</sub>	–	6.0	–	

### SOURCE-DRAIN DIODE CHARACTERISTICS

Forward On-Voltage (Note 2.)	(I <sub>S</sub> = 6 Adc, V <sub>GS</sub> = 0 Vdc) (I <sub>S</sub> = 6 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C)	V <sub>SD</sub>	– –	0.9 0.8	1.0 –	Vdc
Reverse Recovery Time	(I <sub>S</sub> = 6 Adc, V <sub>GS</sub> = 0 Vdc, di <sub>S</sub> /dt = 100 A/μs)	t <sub>rr</sub>	–	251	–	ns
		t <sub>a</sub>	–	168	–	
		t <sub>b</sub>	–	83	–	
Reverse Recovery Stored Charge		Q <sub>RR</sub>	–	2.3	–	μC

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

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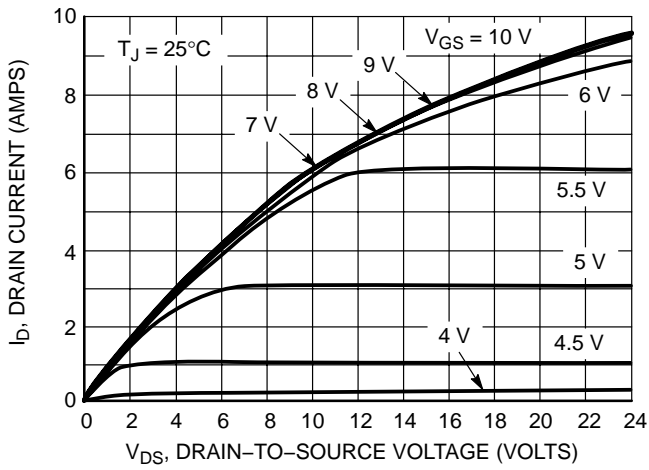


Figure 1. On-Region Characteristics

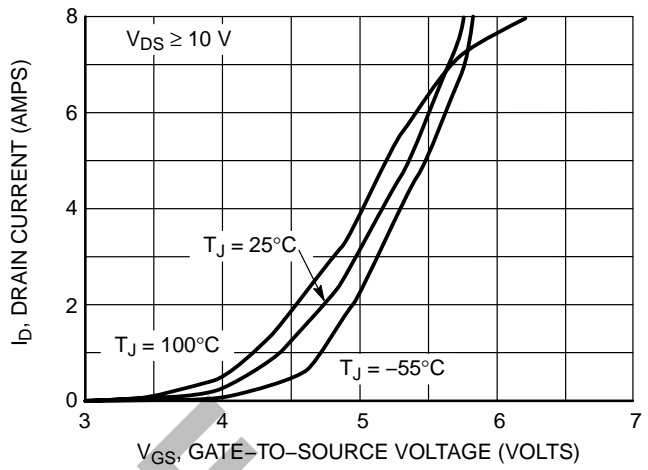


Figure 2. Transfer Characteristics

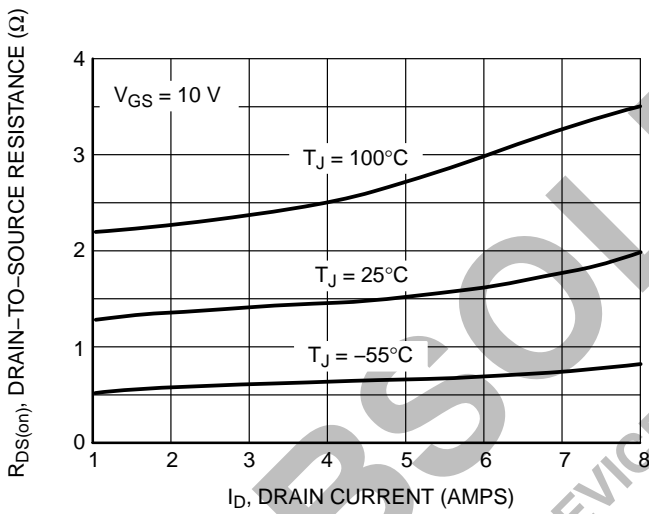


Figure 3. On-Resistance versus Drain Current and Temperature

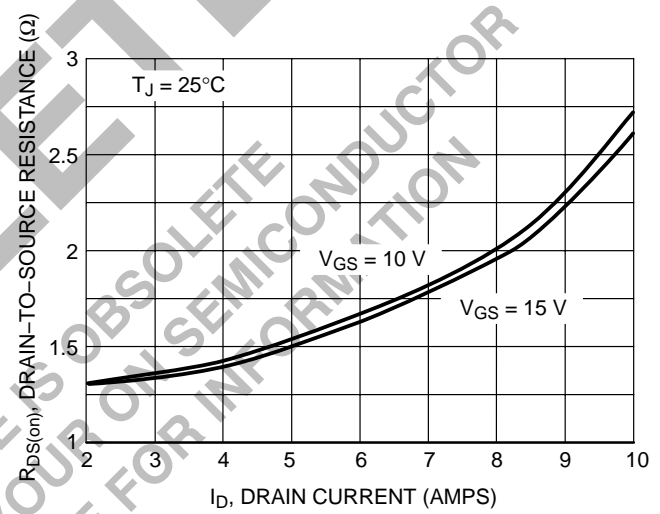


Figure 4. On-Resistance versus Drain Current and Gate Voltage

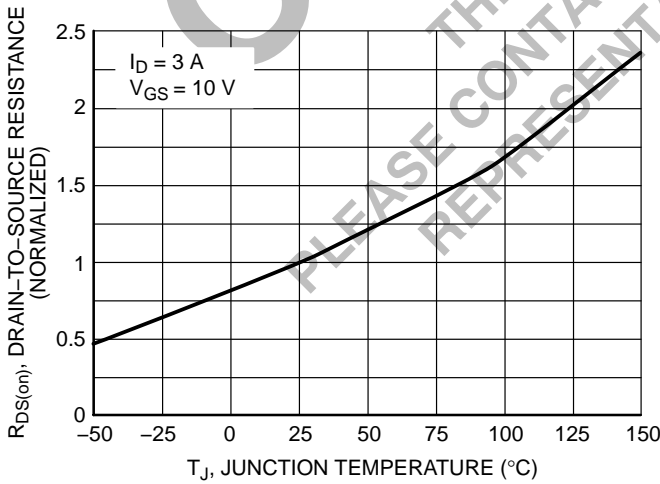


Figure 5. On-Resistance Variation with Temperature

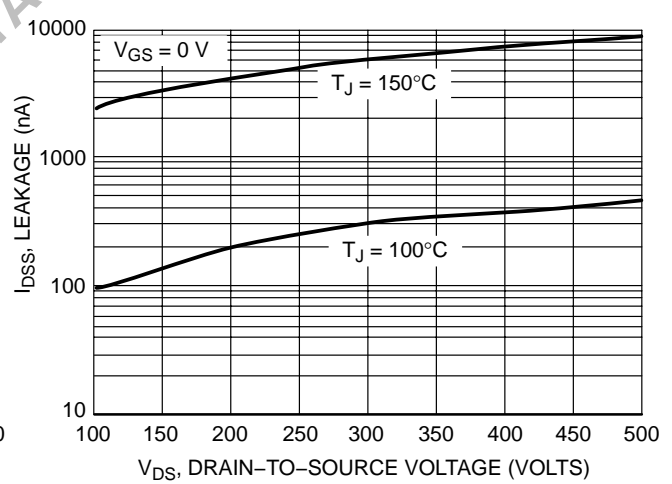


Figure 6. Drain-to-Source Leakage Current versus Voltage

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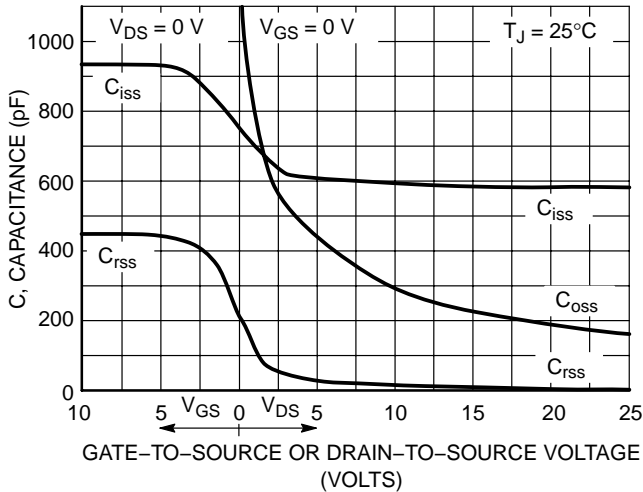


Figure 7. Capacitance Variation

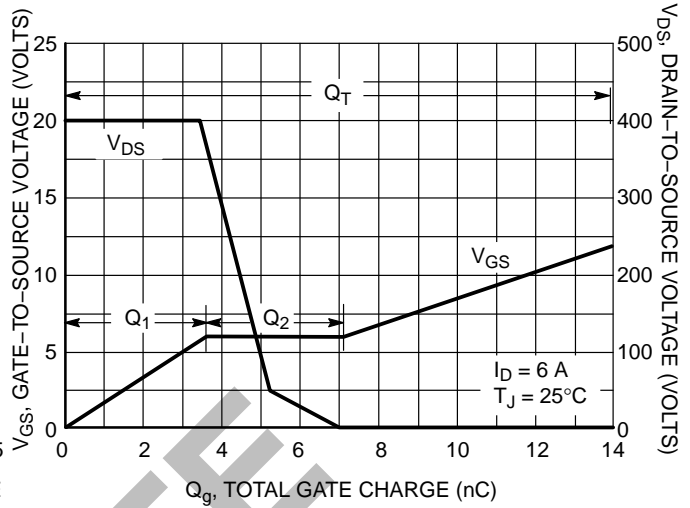


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

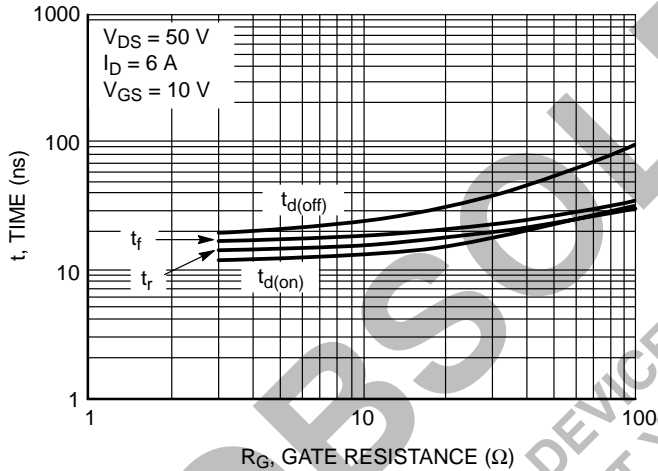


Figure 9. Resistive Switching Time Variation versus Gate Resistance

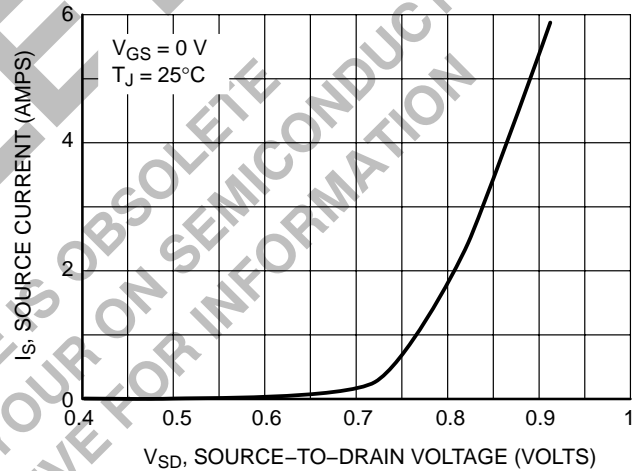


Figure 10. Diode Forward Voltage versus Current

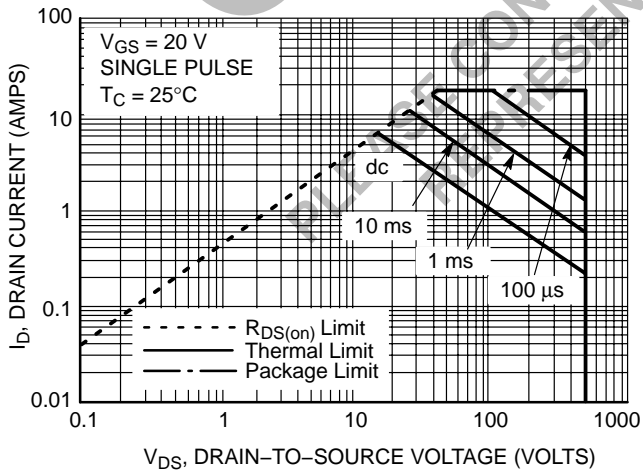


Figure 11. Maximum Rated Forward Biased Safe Operating Area

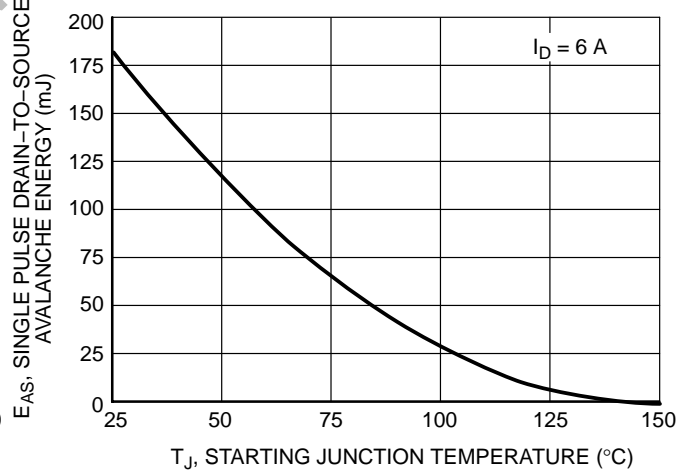


Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature

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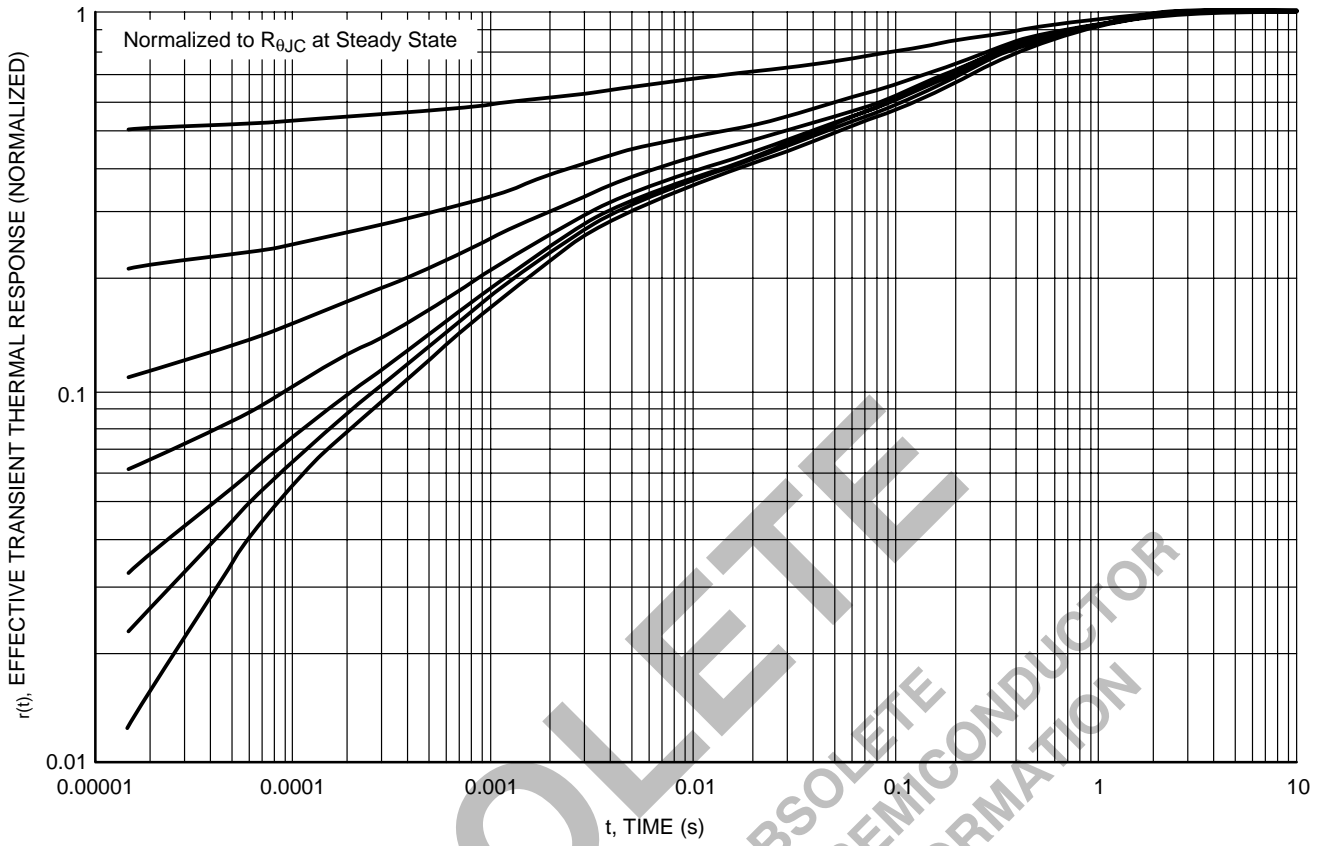
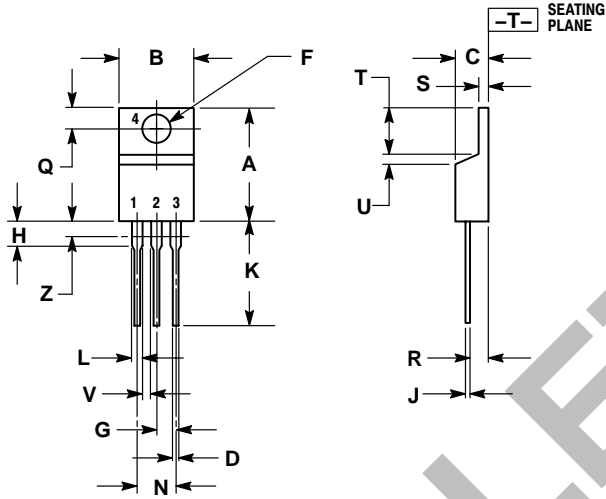


Figure 13. Thermal Response

# NTP6N50

## 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:  
 PIN 1. GATE  
 2. DRAIN


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Notes

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