

# NTP22N06, NTB22N06



## Power MOSFET 22 Amps, 60 Volts

### N-Channel TO-220 and D<sup>2</sup>PAK

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

#### Typical Applications

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

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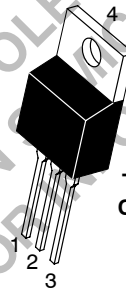
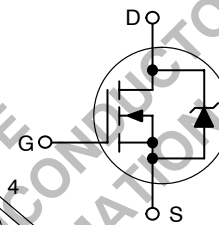
**22 AMPERES  
60 VOLTS**

**$R_{DS(on)} = 60 \text{ m}\Omega$**

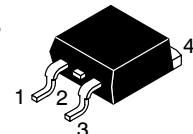
#### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DSS}$	60	Vdc
Drain-to-Gate Voltage ( $R_{GS} = 10 \text{ M}\Omega$ )	$V_{DGR}$	60	Vdc
Gate-to-Source Voltage	$V_{GS}$	$\pm 20$	Vdc
- Continuous	$V_{GS}$	$\pm 30$	
- Non-Repetitive ( $t_p \leq 10 \text{ ms}$ )			
Drain Current	$I_D$	22	Adc
- Continuous @ $T_A = 25^\circ\text{C}$	$I_D$	10	
- Continuous @ $T_A = 100^\circ\text{C}$	$I_{DM}$	66	Apk
- Single Pulse ( $t_p \leq 10 \mu\text{s}$ )			
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	60	W
Derate above $25^\circ\text{C}$		0.4	W/ $^\circ\text{C}$
Operating and Storage Temperature Range	$T_J, T_{stg}$	-55 to +175	$^\circ\text{C}$
Single Pulse Drain-to-Source Avalanche Energy - Starting $T_J = 25^\circ\text{C}$ ( $V_{DD} = 50 \text{ Vdc}$ , $V_{GS} = 10 \text{ Vdc}$ , $L = 1.0 \text{ mH}$ , $V_{DS} = 60 \text{ Vdc}$ , $I_{L(pk)} = 12 \text{ A}$ , $R_G = 25 \Omega$ )	$E_{AS}$	72	mJ
Thermal Resistance	$R_{\theta JC}$	2.5	$^\circ\text{C}/\text{W}$
- Junction-to-Case	$R_{\theta JA}$	62.5	
- Junction-to-Ambient			
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	$T_L$	260	$^\circ\text{C}$

N-Channel

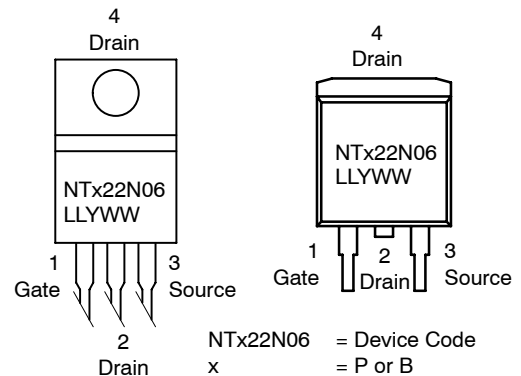


**TO-220AB  
CASE 221A  
STYLE 5**



**D<sup>2</sup>PAK  
CASE 418B  
STYLE 2**

#### MARKING DIAGRAMS & PIN ASSIGNMENTS



NTx22N06 = Device Code  
x = P or B  
LL = Location Code  
Y = Year  
WW = Work Week

#### ORDERING INFORMATION

Device	Package	Shipping
NTP22N06	TO-220AB	50 Units/Rail
NTB22N06	D <sup>2</sup> PAK	50 Units/Rail
NTB22N06T4	D <sup>2</sup> PAK	800/Tape & Reel

# NTP22N06, NTB22N06

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Drain-to-Source Breakdown Voltage (Note 1) (V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = 250 μAdc) Temperature Coefficient (Positive)	V <sub>(BR)DSS</sub>	60 -	71 71	- -	Vdc mV/°C
Zero Gate Voltage Drain Current (V <sub>DS</sub> = 60 Vdc, V <sub>GS</sub> = 0 Vdc) (V <sub>DS</sub> = 60 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 150°C)	I <sub>DSS</sub>	- -	- -	1.0 10	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 1)

Gate Threshold Voltage (Note 1) (V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μAdc) Threshold Temperature Coefficient (Negative)	V <sub>GS(th)</sub>	2.0 -	3.09 7.0	4.0 -	Vdc mV/°C
Static Drain-to-Source On-Resistance (Note 1) (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 11 Adc)	R <sub>DS(on)</sub>	-	52	60	mΩ
Static Drain-to-Source On-Voltage (Note 1) (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 22 Adc) (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 11 Adc, T <sub>J</sub> = 150°C)	V <sub>DS(on)</sub>	- -	1.2 1.11	1.6 -	Vdc
Forward Transconductance (Note 1) (V <sub>DS</sub> = 7.0 Vdc, I <sub>D</sub> = 11 Adc)	g <sub>FS</sub>	-	12	-	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>	-	502	700	pF
Output Capacitance		C <sub>oss</sub>	-	160	225	
Transfer Capacitance		C <sub>rss</sub>	-	46	65	

## SWITCHING CHARACTERISTICS (Note 2)

Turn-On Delay Time	(V <sub>DD</sub> = 30 Vdc, I <sub>D</sub> = 22 Adc, V <sub>GS</sub> = 10 Vdc, R <sub>G</sub> = 9.1 Ω) (Note 1)	t <sub>d(on)</sub>	-	12	25	ns
Rise Time		t <sub>r</sub>	-	39	80	
Turn-Off Delay Time		t <sub>d(off)</sub>	-	18	40	
Fall Time		t <sub>f</sub>	-	34	70	
Gate Charge	(V <sub>DS</sub> = 48 Vdc, I <sub>D</sub> = 22 Adc, V <sub>GS</sub> = 10 Vdc) (Note 1)	Q <sub>T</sub>	-	15.5	32	nC
		Q <sub>1</sub>	-	3.4	-	
		Q <sub>2</sub>	-	7.7	-	

## SOURCE-DRAIN DIODE CHARACTERISTICS

Forward On-Voltage	(I <sub>S</sub> = 22 Adc, V <sub>GS</sub> = 0 Vdc) (Note 1) (I <sub>S</sub> = 22 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 150°C)	V <sub>SD</sub>	- -	1.07 1.0	1.15 -	Vdc
Reverse Recovery Time	(I <sub>S</sub> = 22 Adc, V <sub>GS</sub> = 0 Vdc, di <sub>S</sub> /dt = 100 A/μs) (Note 1)	t <sub>rr</sub>	-	43	-	ns
		t <sub>a</sub>	-	32	-	
		t <sub>b</sub>	-	11	-	
Reverse Recovery Stored Charge		Q <sub>RR</sub>	-	0.071	-	μC

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

# NTP22N06, NTB22N06

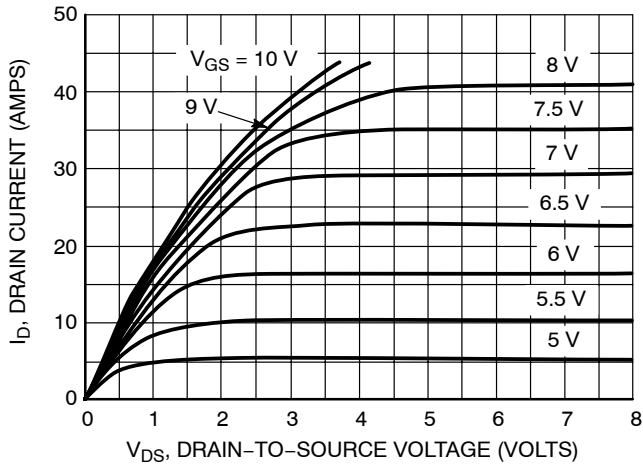


Figure 1. On-Region Characteristics

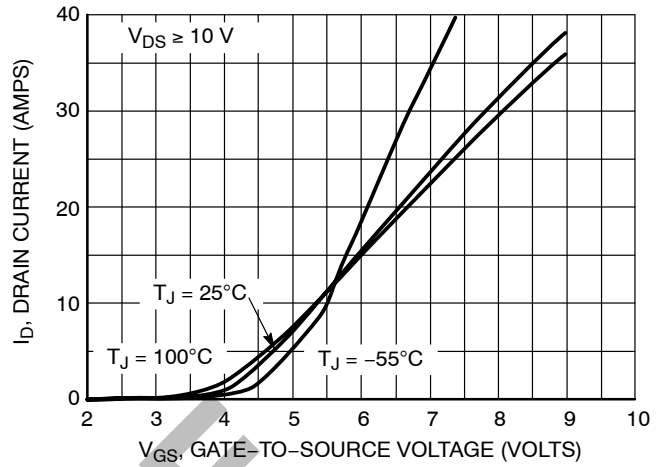


Figure 2. Transfer Characteristics

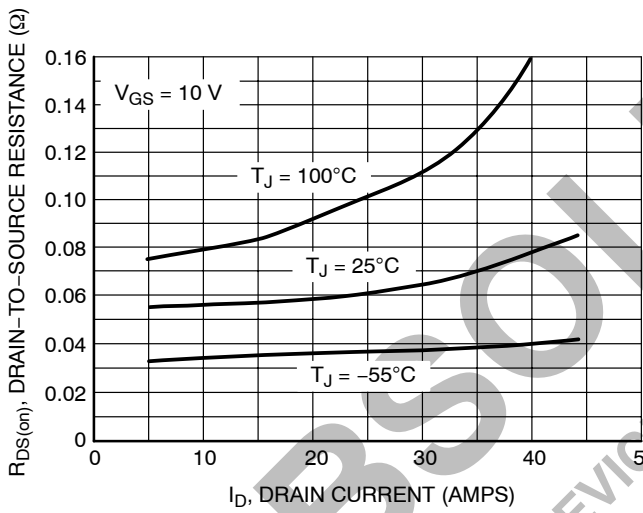


Figure 3. On-Resistance versus Gate-to-Source Voltage

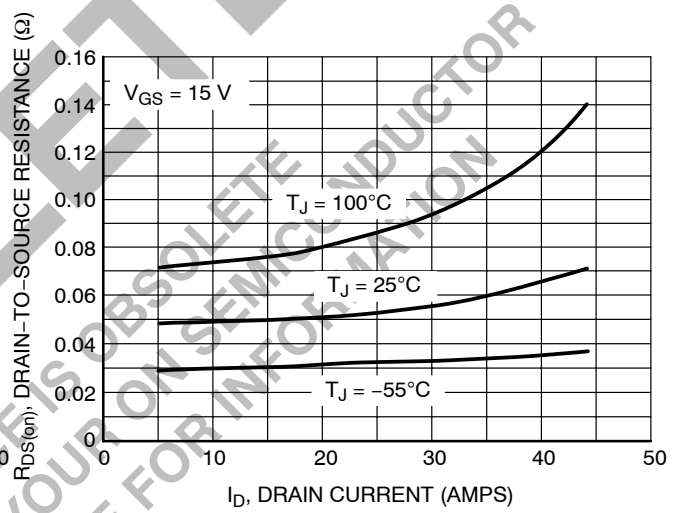


Figure 4. On-Resistance versus Drain Current and Gate Voltage

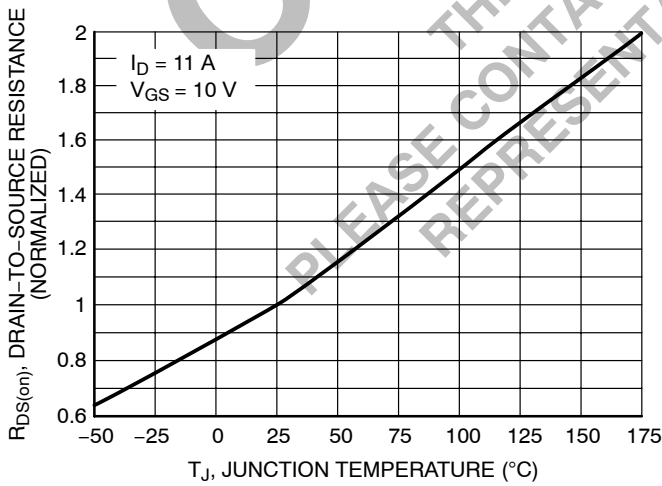


Figure 5. On-Resistance Variation with Temperature

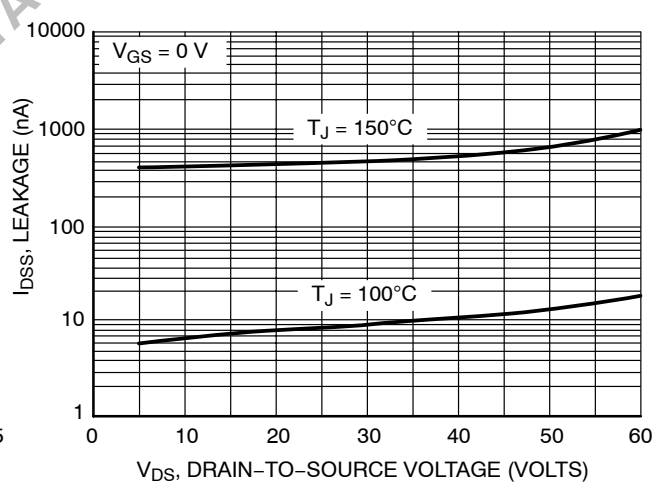


Figure 6. Drain-to-Source Leakage Current versus Voltage

# NTP22N06, NTB22N06

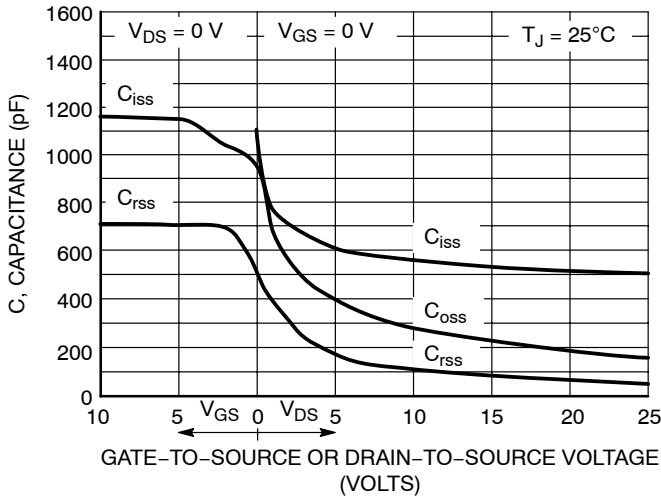


Figure 7. Capacitance Variation

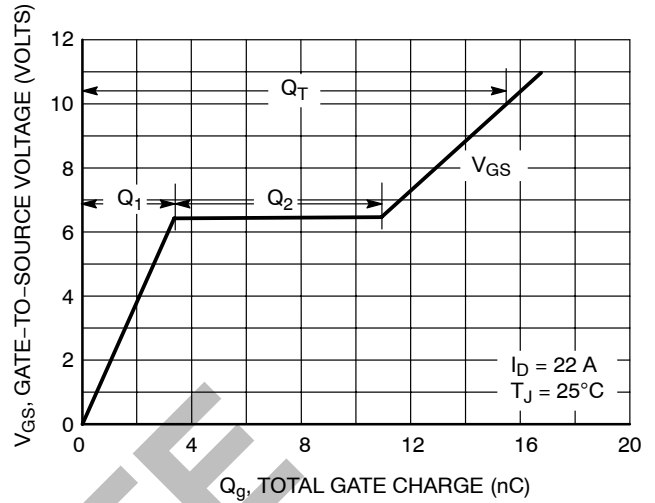


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

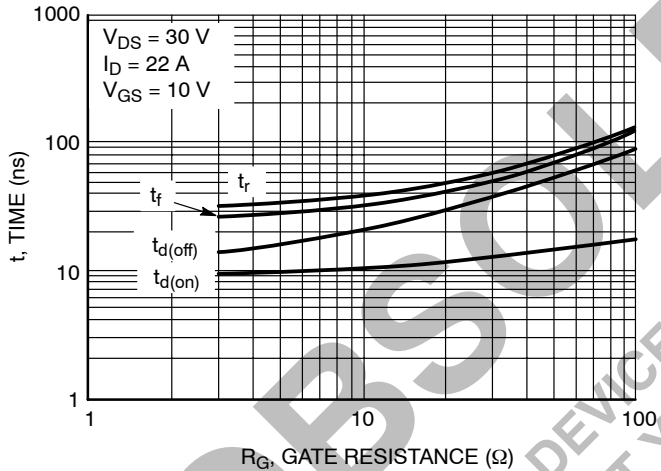


Figure 9. Resistive Switching Time Variation versus Gate Resistance

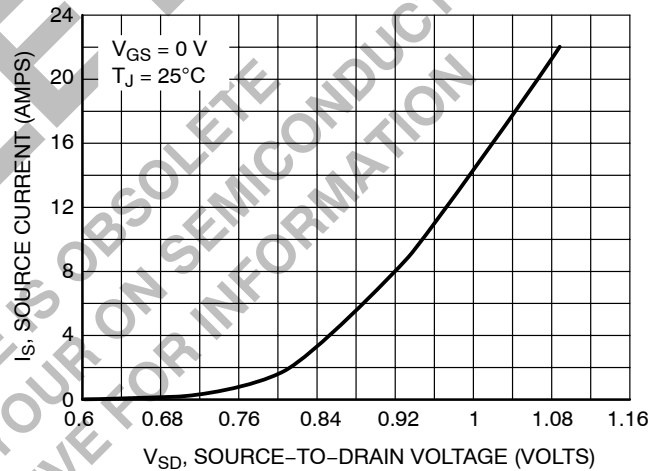


Figure 10. Diode Forward Voltage versus Current

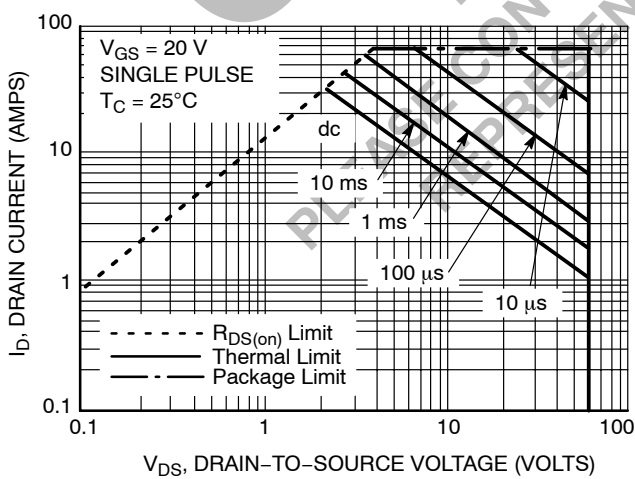


Figure 11. Maximum Rated Forward Biased Safe Operating Area

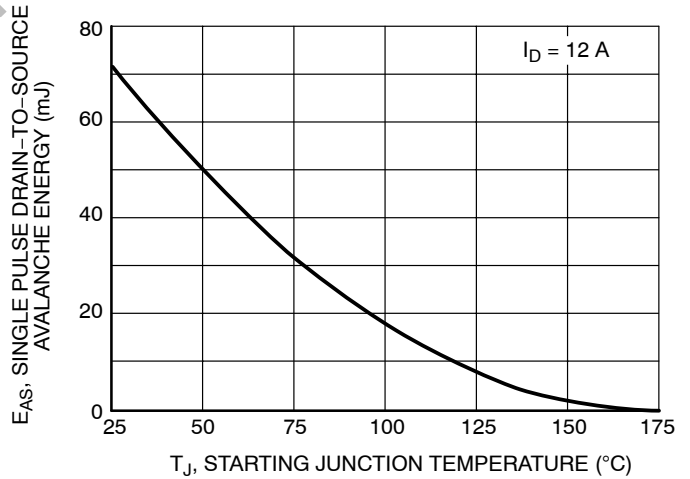


Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature

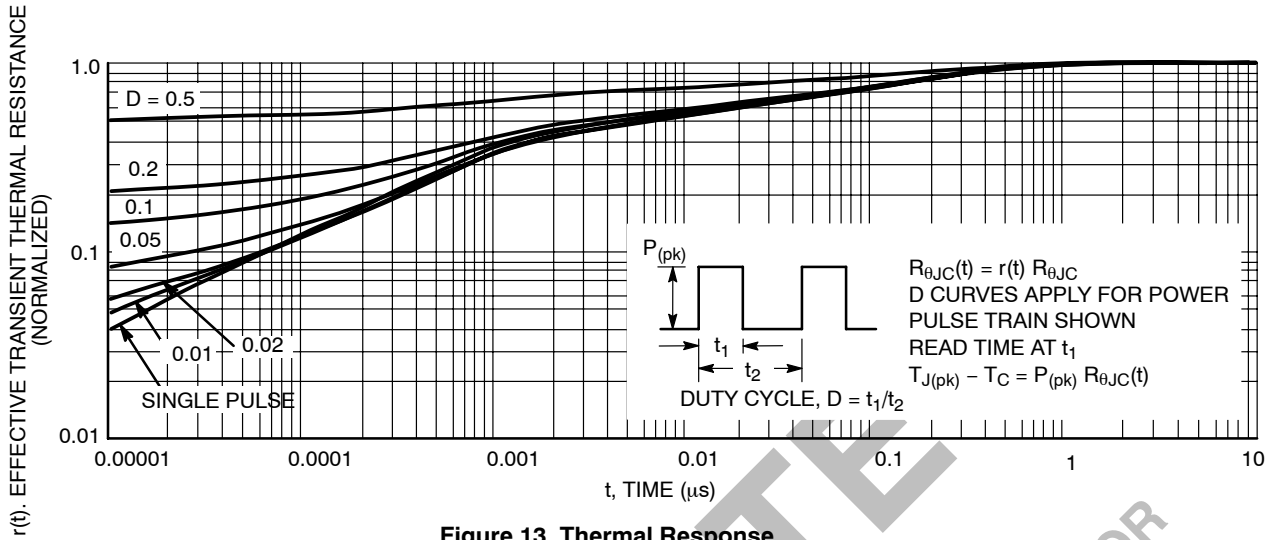


Figure 13. Thermal Response

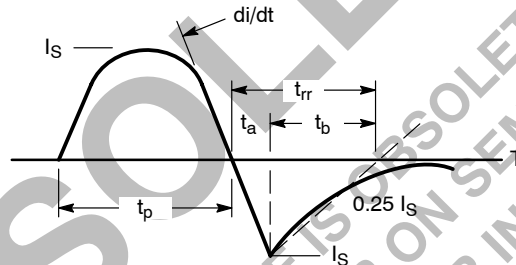
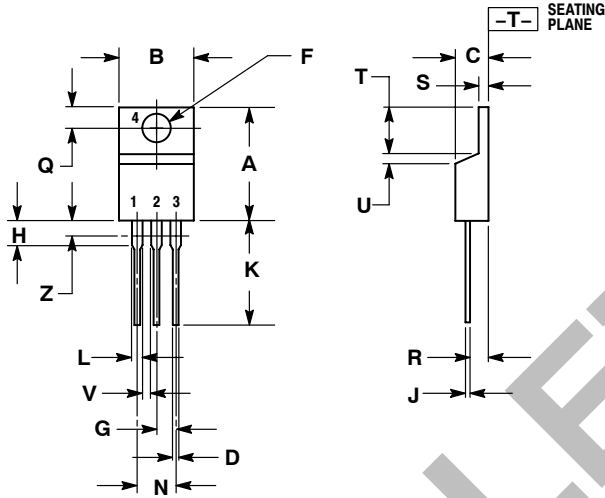


Figure 14. Diode Reverse Recovery Waveform

# NTP22N06, NTB22N06

## PACKAGE DIMENSIONS

TO-220 THREE-LEAD  
TO-220AB  
CASE 221A-09  
ISSUE AA



NOTES:

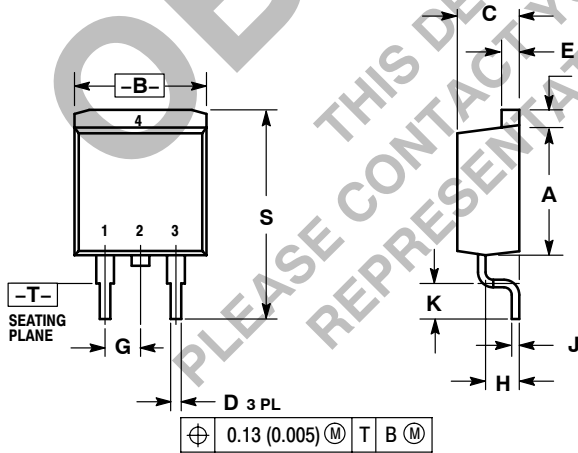
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

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	4.89	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
- DRAIN
- SOURCE
- DRAIN

D<sup>2</sup>PAK  
CASE 418B-03  
ISSUE D



NOTES:


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

DIM	INCHES		MILLIMETERS	
	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
- DRAIN
- SOURCE
- DRAIN

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