

# 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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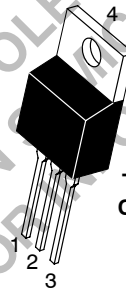
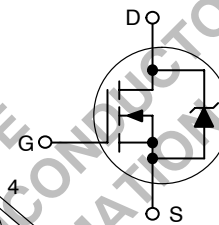
**22 AMPERES  
60 VOLTS**

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

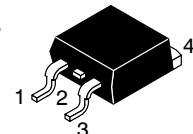
#### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

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

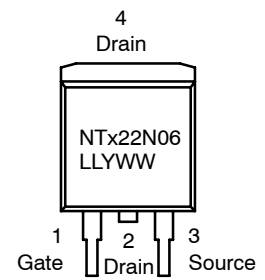
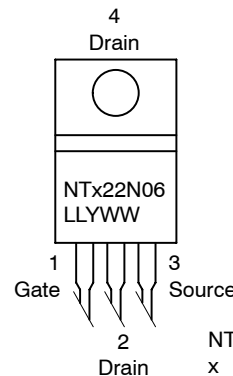


**TO-220AB  
CASE 221A  
STYLE 5**



**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		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

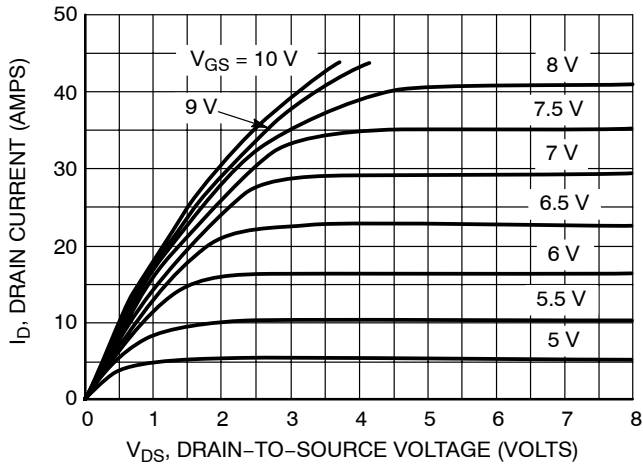


Figure 1. On-Region Characteristics

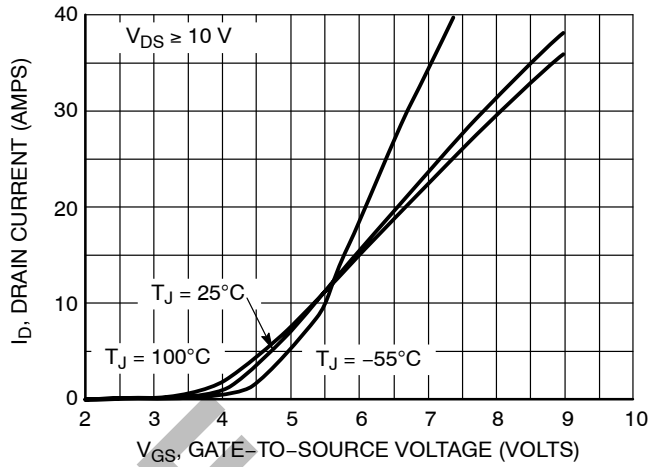


Figure 2. Transfer Characteristics

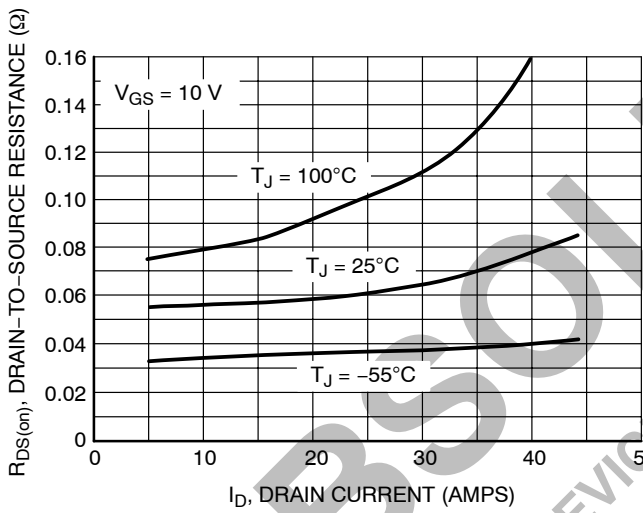


Figure 3. On-Resistance versus Gate-to-Source Voltage

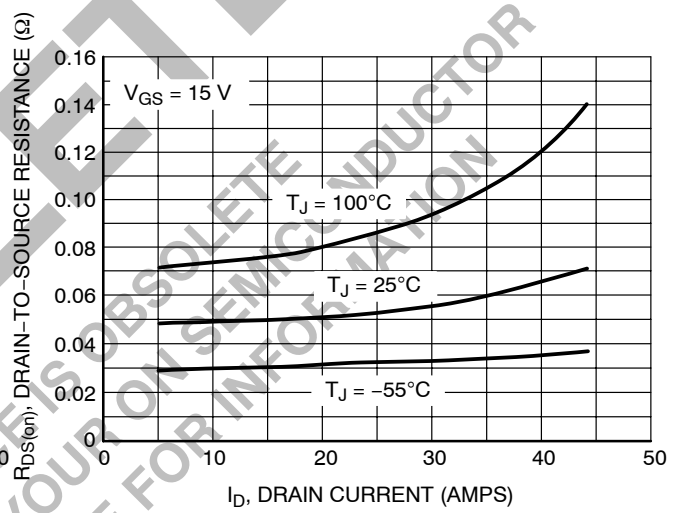


Figure 4. On-Resistance versus Drain Current and Gate Voltage

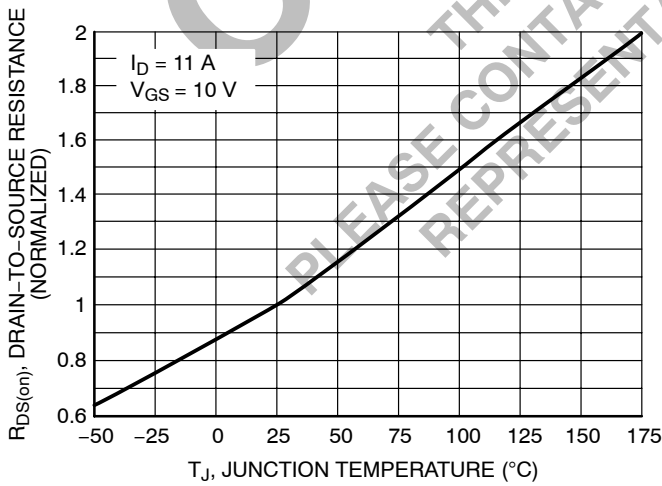


Figure 5. On-Resistance Variation with Temperature

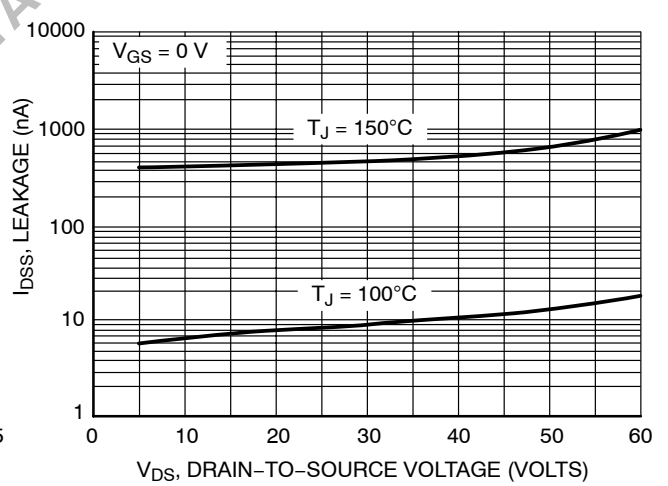
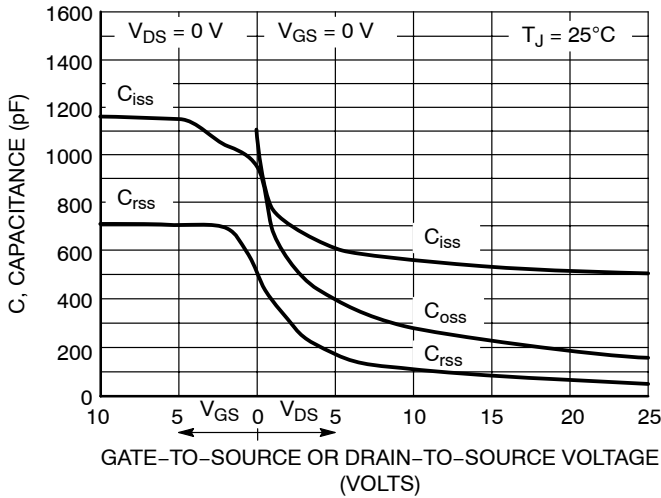
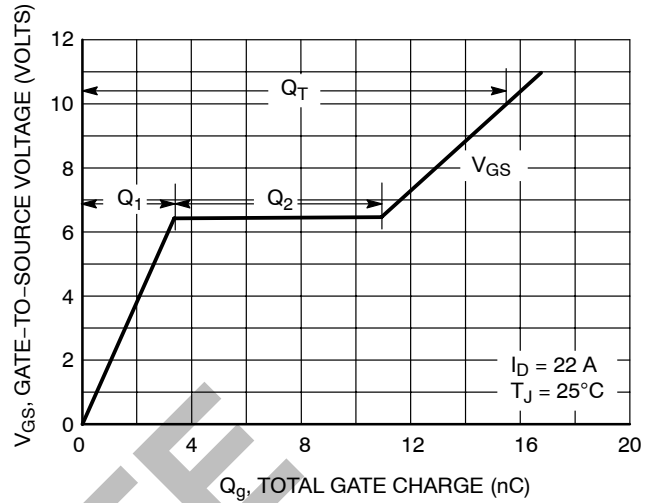


Figure 6. Drain-to-Source Leakage Current versus Voltage

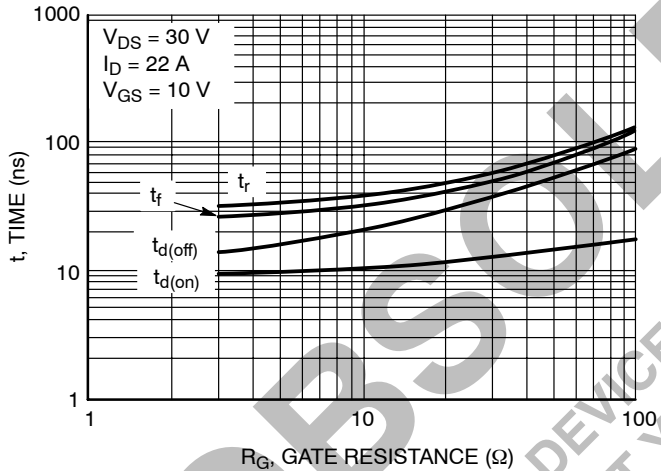
# NTP22N06, NTB22N06



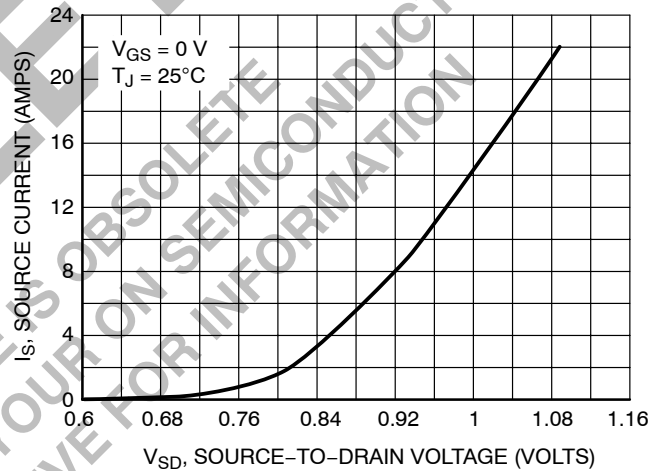
**Figure 7. Capacitance Variation**



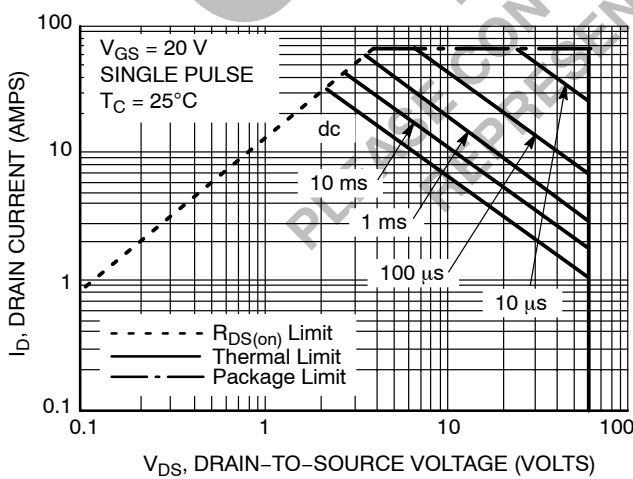
**Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge**



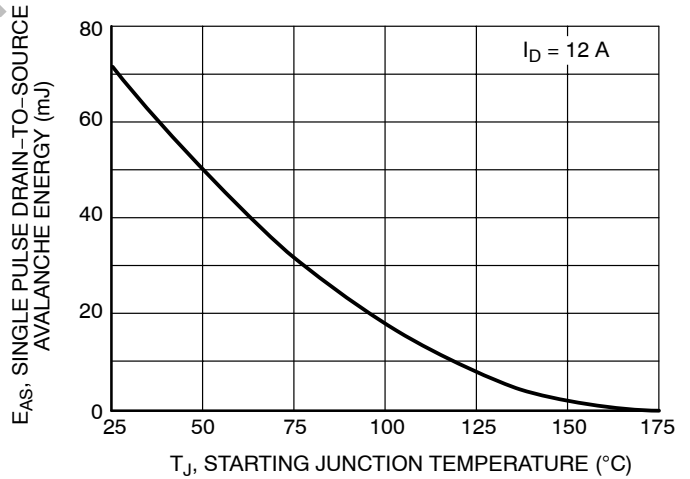
**Figure 9. Resistive Switching Time Variation versus Gate Resistance**



**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**

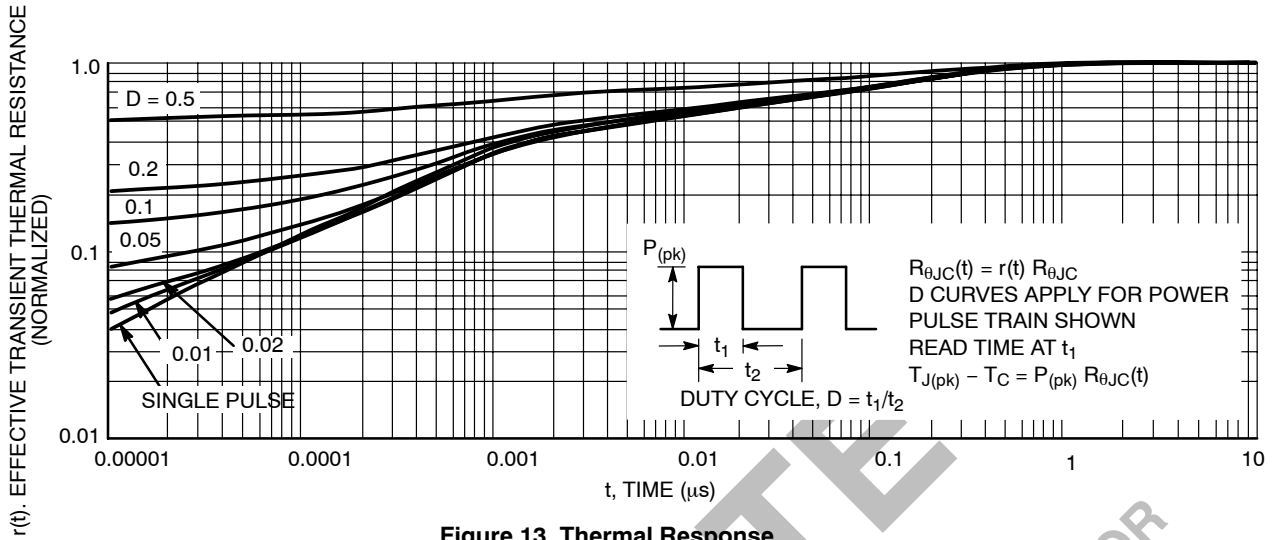


Figure 13. Thermal Response

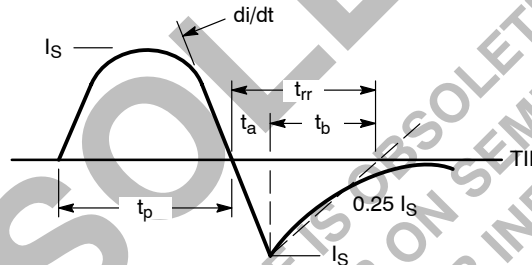
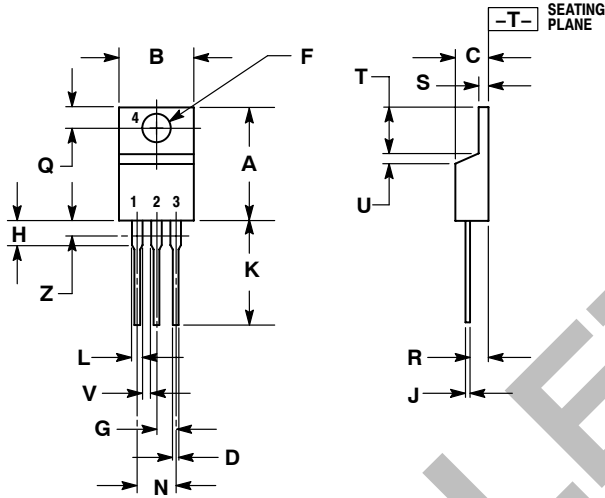


Figure 14. Diode Reverse Recovery Waveform

# NTP22N06, NTB22N06

## PACKAGE DIMENSIONS

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



NOTES:

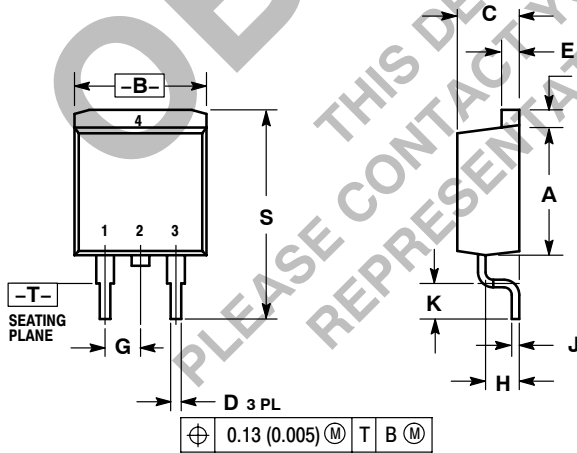
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

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

**OBSOLETE**  
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