

# NTP10N60, NTB10N60

Preferred Devices

Advance Information

## Power MOSFET 10 Amps, 600 Volts N-Channel TO-220 and D<sup>2</sup>PAK

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	$V_{DSS}$	600	Vdc
Drain-Gate Voltage ( $R_{GS} = 1.0\text{ M}\Omega$ )	$V_{DGR}$	600	Vdc
Gate-Source Voltage	$V_{GS}$	$\pm 20$	Vdc
– Continuous	$V_{GS}$	$\pm 20$	
– Non-Repetitive ( $t_p \leq 10\text{ ms}$ )	$V_{GSM}$	$\pm 40$	
Drain-Continuous	$I_D$	10	Adc
– Continuous @ $100^\circ\text{C}$	$I_D$	8.0	
– Single Pulse ( $t_p \leq 10\ \mu\text{s}$ )	$I_{DM}$	35	
Total Power Dissipation	$P_D$	201	Watts
Derate above $25^\circ\text{C}$		1.61	$\text{W}/^\circ\text{C}$
Operating and Storage Temperature Range	$T_J, T_{stg}$	$-55$ to $+150$	$^\circ\text{C}$
Single Drain-to-Source Avalanche Energy – Starting $T_J = 25^\circ\text{C}$ ( $V_{DD} = 100\text{ V}$ , $V_{GS} = 10\text{ Vdc}$ , $I_L = 10\text{ A}$ , $L = 10\text{ mH}$ , $R_G = 25\ \Omega$ )	$E_{AS}$	500	mJ
Thermal Resistance			$^\circ\text{C}/\text{W}$
– Junction-to-Case	$R_{\theta JC}$	0.62	
– Junction-to-Ambient	$R_{\theta JA}$	62.5	
– Junction-to-Ambient (Note 1.)	$R_{\theta JA}$	50	
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	$T_L$	260	$^\circ\text{C}$

1. When surface mounted to an FR4 board using the minimum recommended pad size.

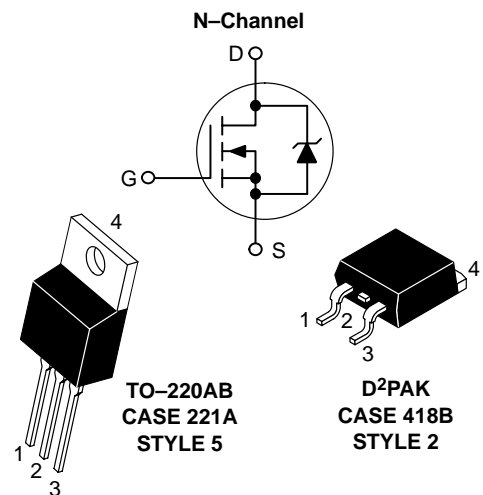
This document contains information on a new product. Specifications and information herein are subject to change without notice.



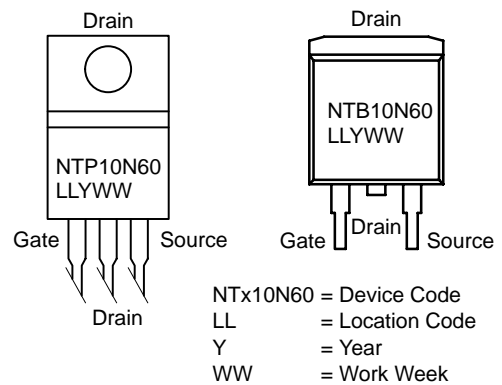
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**10 AMPERES**  
**600 VOLTS**  
 $R_{DS(on)} = 0.75\ \Omega$



### MARKING DIAGRAMS AND PIN ASSIGNMENTS



### ORDERING INFORMATION

Device	Package	Shipping
NTP10N60	TO-220AB	50 Units/Rail
NTB10N60	D <sup>2</sup> PAK	50 Units/Rail
NTB10N60T4	D <sup>2</sup> PAK	800/Tape & Reel

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

# NTP10N60, NTB10N60

## 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 (V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = 0.25 mAdc) Temperature Coefficient (Positive)	V <sub>(BR)DSS</sub>	600 –	– 585	– –	Vdc mV/°C
Zero Gate Voltage Collector Current (V <sub>DS</sub> = 600 Vdc, V <sub>GS</sub> = 0 Vdc) (V <sub>DS</sub> = 600 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)	I <sub>GSS(f)</sub> I <sub>GSS(r)</sub>	– –	– –	100 100	nAdc

### ON CHARACTERISTICS (Note 1.)

Gate Threshold Voltage I <sub>D</sub> = 0.25 mA, V <sub>DS</sub> = V <sub>GS</sub> Temperature Coefficient (Negative)	V <sub>GS(th)</sub>	2.0 –	2.5 5.8	4.0 –	Vdc mV/°C
Static Drain-to-Source On-Resistance (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 5 Adc)	R <sub>DS(on)</sub>	–	0.6	0.75	Ohm
Drain-to-Source On-Voltage (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 10 Adc) (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 5 Adc, T <sub>J</sub> = 125°C)	V <sub>DS(on)</sub>	– –	– –	9.0 7.9	Vdc
Forward Transconductance (V <sub>DS</sub> = 8 Vdc, I <sub>D</sub> = 5 Adc)	g <sub>FS</sub>	3.0	10	–	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>	–	1840	2580	pF
Output Capacitance		C <sub>oss</sub>	–	470	660	
Transfer Capacitance		C <sub>riss</sub>	–	20	40	

### SWITCHING CHARACTERISTICS (Note 2.)

Turn-On Delay Time	(V <sub>DD</sub> = 300 Vdc, I <sub>D</sub> = 10 Adc, V <sub>GS</sub> = 10 Vdc, R <sub>G</sub> = 9.1 Ω)	t <sub>d(on)</sub>	–	11.5	20	ns
Rise Time		t <sub>r</sub>	–	20	40	
Turn-Off Delay Time		t <sub>d(off)</sub>	–	50	100	
Fall Time		t <sub>f</sub>	–	30	60	
Gate Charge	(V <sub>DS</sub> = 400 Vdc, I <sub>D</sub> = 10 Adc, V <sub>GS</sub> = 10 Vdc)	Q <sub>T</sub>	–	36	50	nC
		Q <sub>1</sub>	–	8.0	–	
		Q <sub>2</sub>	–	11	–	
		Q <sub>3</sub>	–	20	–	

### SOURCE-DRAIN DIODE CHARACTERISTICS

Forward On-Voltage (Note 1.)	(I <sub>S</sub> = 10 Adc, V <sub>GS</sub> = 0 Vdc) (I <sub>S</sub> = 10 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C)	V <sub>SD</sub>	– –	0.85 0.75	1.0 –	Vdc
Reverse Recovery Time	(I <sub>S</sub> = 10 Adc, V <sub>GS</sub> = 0 Vdc, dis/dt = 100 A/μs)	t <sub>rr</sub>	–	510	–	ns
		t <sub>a</sub>	–	165	–	
		t <sub>b</sub>	–	345	–	
Reverse Recovery Stored Charge		Q <sub>RR</sub>	–	4.1	–	μC

### INTERNAL PACKAGE INDUCTANCE

Internal Drain Inductance (Measured from contact screw on tab to center of die) (Measured from the drain lead 0.25" from package to center of die)	L <sub>D</sub>	– –	3.5 4.5	– –	nH
Internal Source Inductance (Measured from the source lead 0.25" from package to source bond pad)	L <sub>S</sub>	–	7.5	–	

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

# NTP10N60, NTB10N60

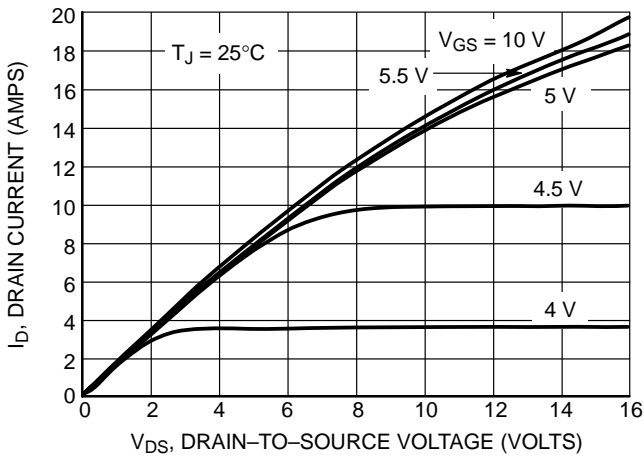


Figure 1. On-Region Characteristics

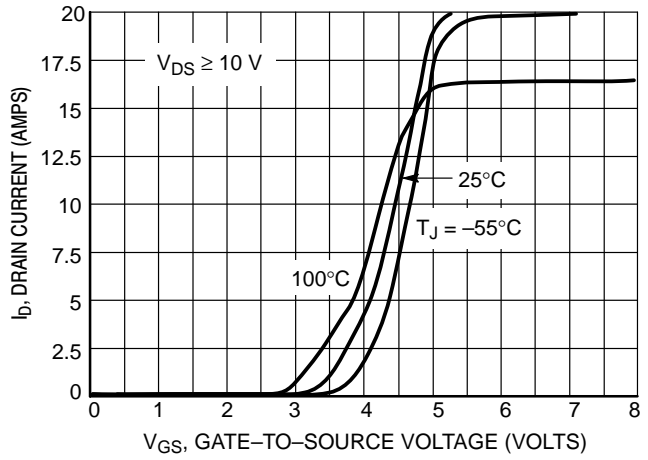


Figure 2. Transfer Characteristics

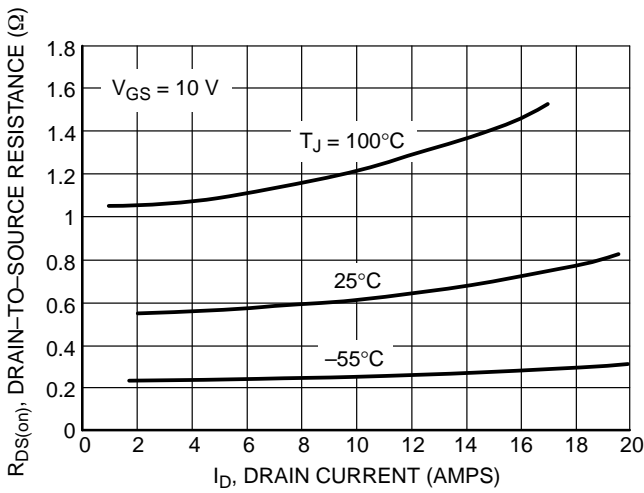


Figure 3. On-Resistance versus Drain Current and Temperature

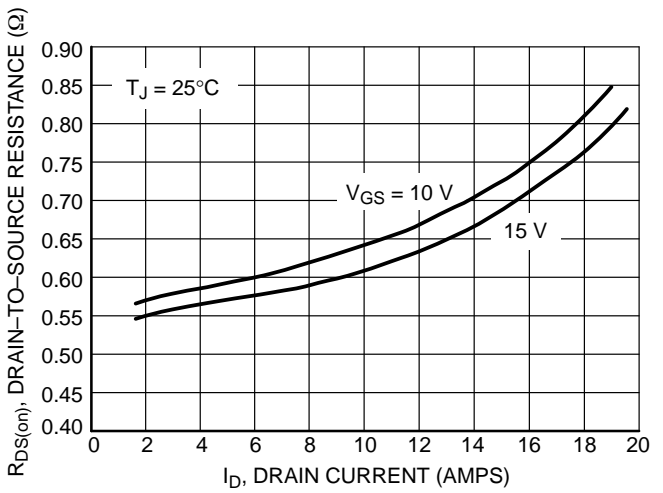


Figure 4. On-Resistance versus Drain Current and Gate Voltage

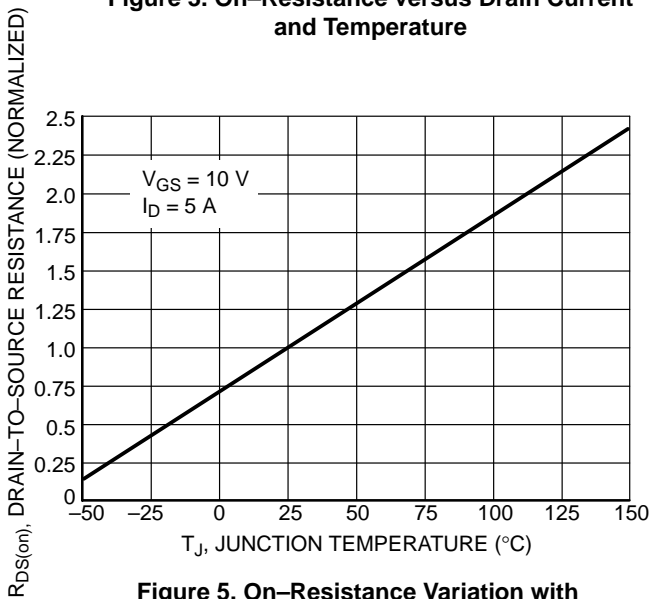


Figure 5. On-Resistance Variation with Temperature

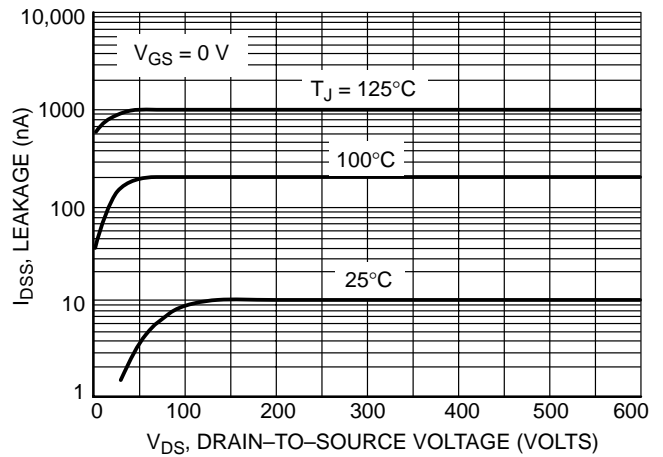


Figure 6. Drain-to-Source Leakage Current versus Voltage

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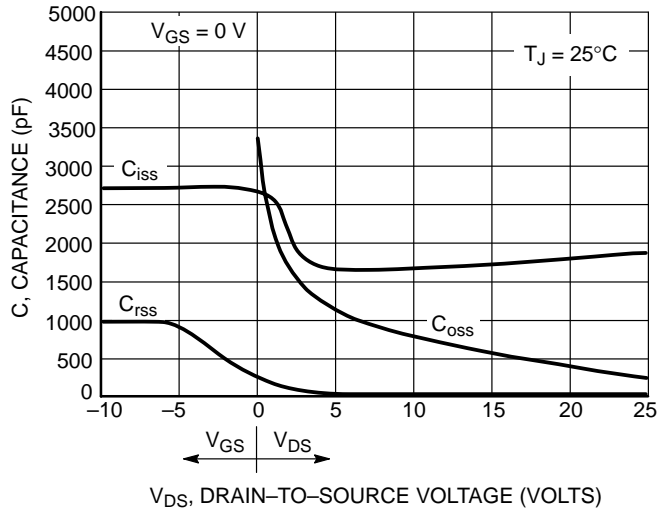


Figure 7. Capacitance Variation

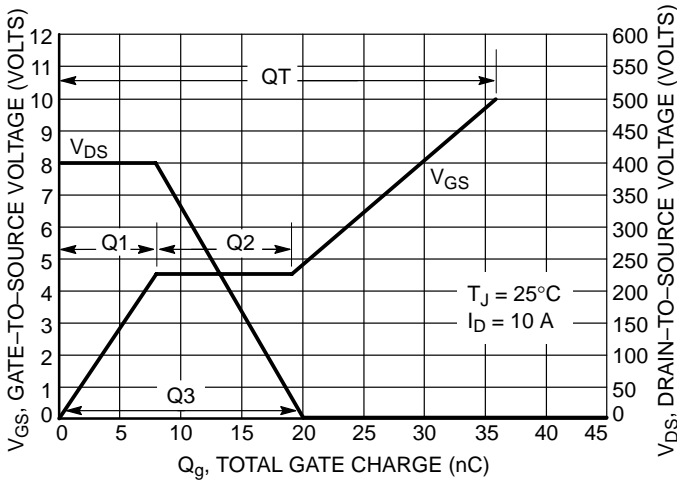


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

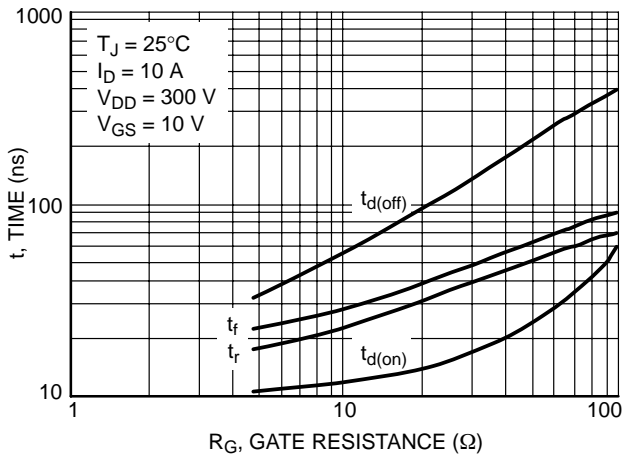


Figure 9. Resistive Switching Time Variation versus Gate Resistance

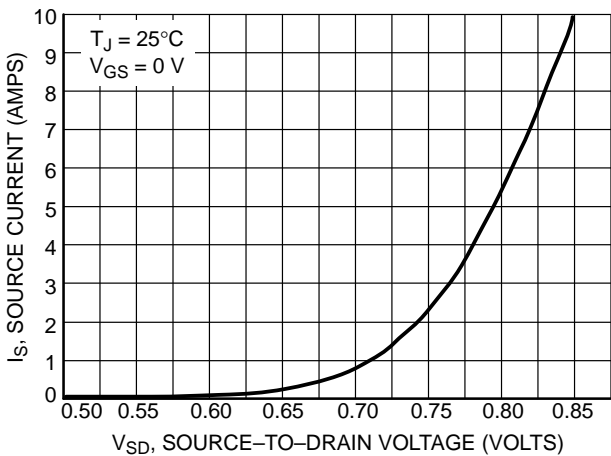


Figure 10. Diode Forward Voltage versus Current

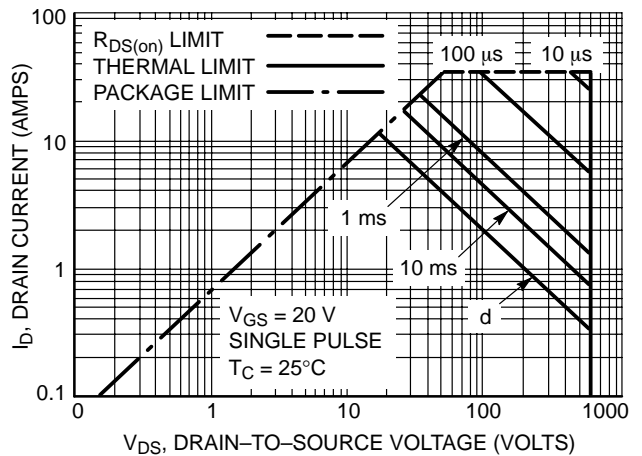


Figure 11. Maximum Rated Forward Biased Safe Operating Area

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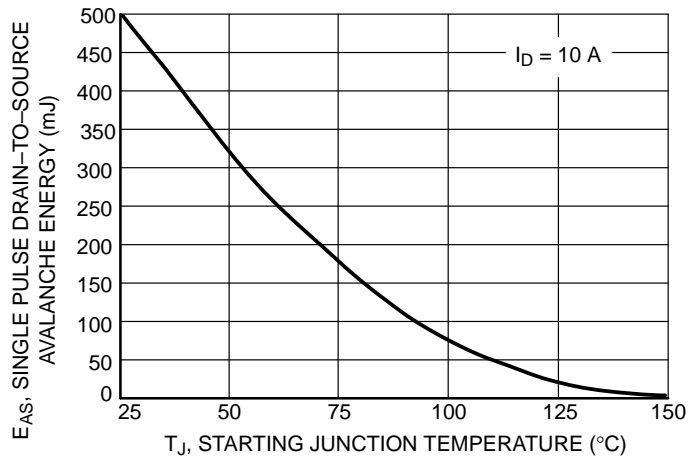


Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature

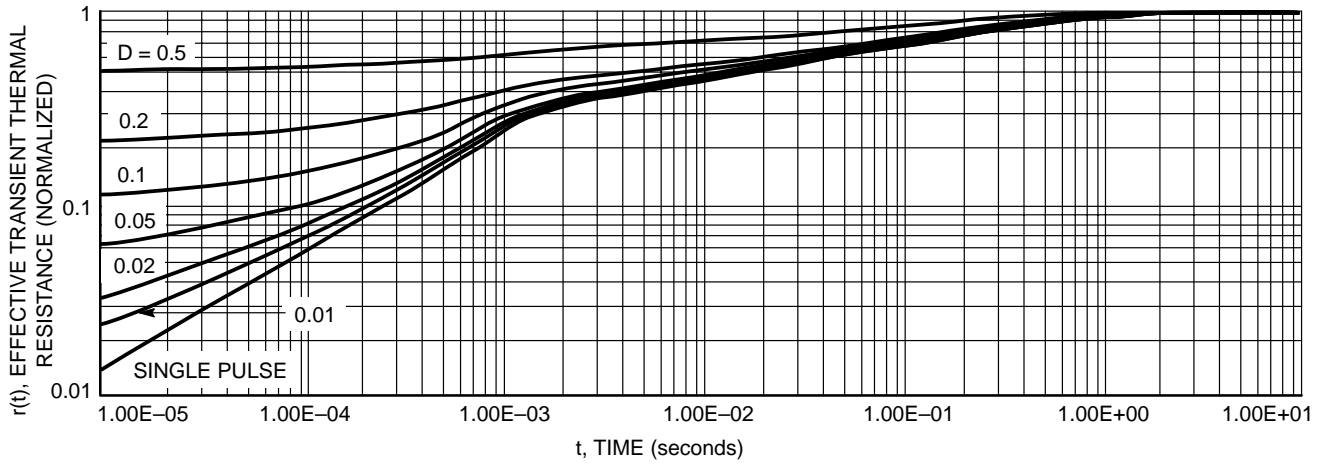


Figure 13. Thermal Response

# NTP10N60, NTB10N60

## 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

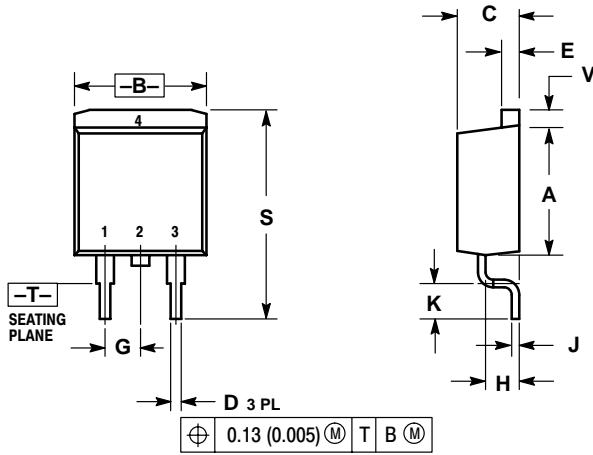
#### STYLE 5:

- PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

# NTP10N60, NTB10N60

## PACKAGE DIMENSIONS

**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  
2. DRAIN  
3. SOURCE  
4. DRAIN

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