

NTB5404N, NTP5404N, NVB5404N

Power MOSFET

40 V, 167 A, Single N-Channel, D²PAK & TO-220

Features

- Low $R_{DS(on)}$
- High Current Capability
- Low Gate Charge
- AEC-Q101 Qualified and PPAP Capable – NVB5404N
- These Devices are Pb-Free and are RoHS Compliant

Applications

- Electronic Brake Systems
- Electronic Power Steering
- Bridge Circuits

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

Parameter		Symbol	Value	Units	
Drain-to-Source Voltage		V_{DSS}	40	V	
Gate-to-Source Voltage		V_{GS}	± 20	V	
Continuous Drain Current – $R_{\theta JC}$	Steady State	$T_C = 25^\circ\text{C}$	I_D	167	A
			$T_C = 100^\circ\text{C}$	118	
Power Dissipation – $R_{\theta JC}$	Steady State	$T_C = 25^\circ\text{C}$	P_D	254	W
Continuous Drain Current – $R_{\theta JA}$ (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	I_D	24	A
			$T_A = 100^\circ\text{C}$	17	
Power Dissipation – $R_{\theta JA}$ (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	P_D	5.4	W
Pulsed Drain Current	$t_p = 10 \mu\text{s}$		I_{DM}	670	A
Operating Junction and Storage Temperature		T_J, T_{STG}	-55 to 175	$^\circ\text{C}$	
Source Current (Body Diode) Pulsed		I_S	75	A	
Single Pulse Drain-to-Source Avalanche Energy – ($V_{DD} = 50 \text{ V}, V_{GS} = 10 \text{ V}, I_{PK} = 45 \text{ A}, L = 1 \text{ mH}, R_G = 25 \Omega$)		EAS	1000	mJ	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)		T_L	260	$^\circ\text{C}$	

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Case (Drain)	$R_{\theta JC}$	0.59	$^\circ\text{C/W}$
Junction-to-Ambient (Note 1)	$R_{\theta JA}$	50	$^\circ\text{C/W}$

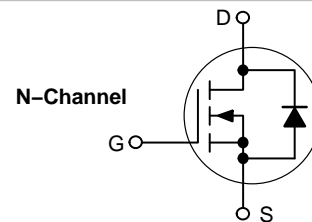
1. Surface mounted on FR4 board using 1 sq in pad size, (Cu Area 1.127 sq in [2 oz] including traces).



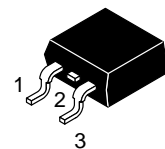
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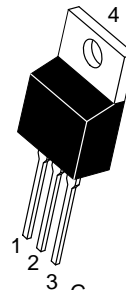
$V_{(BR)DSS}$	$R_{DS(on) MAX}$	$I_D MAX$ (Note 1)
40 V	4.5 m Ω @ 10 V	167 A



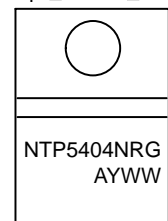
MARKING DIAGRAMS



D²PAK
CASE 418B
STYLE 2



TO-220AB
CASE 221A
STYLE 5



G = Pb-Free Device
A = Assembly Location
Y = Year
WW = Work Week

ORDERING INFORMATION

Device	Package	Shipping†
NTB5404NT4G	D ² PAK (Pb-Free)	800 / Tape & Reel
NTP5404NRG	TO-220 (Pb-Free)	50 Units / Rail
NVB5404NT4G	D ² PAK (Pb-Free)	800 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise stated)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Drain-to-Source Breakdown Voltage	V _{(BR)DSS}	V _{GS} = 0 V, I _D = 250 μA	40			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	V _{(BR)DSS} /T _J			34		mV/°C
Zero Gate Voltage Drain Current	I _{DSS}	V _{GS} = 0 V, V _{DS} = 40 V	T _J = 25°C		1.0	μA
			T _J = 100°C		10	
Gate-to-Source Leakage Current	I _{GSS}	V _{DS} = 0 V, V _{GS} = ±30 V			±100	nA

ON CHARACTERISTICS (Note 2)

Gate Threshold Voltage	V _{GS(TH)}	V _{GS} = V _{DS} , I _D = 250 μA	1.5		3.5	V
Gate Threshold Temperature Coefficient	V _{GS(TH)} /T _J			-8.2		mV/°C
Drain-to-Source On Resistance	R _{DS(on)}	V _{GS} = 10 V, I _D = 40 A		3.5	4.5	mΩ
		V _{GS} = 5.0 V, I _D = 15 A		5.1	7.0	
Forward Transconductance	g _{FS}	V _{DS} = 10 V, I _D = 15 A		35		S

CHARGES AND CAPACITANCES

Input Capacitance	C _{ISS}	V _{GS} = 0 V, f = 1.0 MHz, V _{DS} = 32 V		4300	7000	pF
Output Capacitance	C _{OSS}			1075	1700	
Reverse Transfer Capacitance	C _{RSS}			450	1000	
Total Gate Charge	Q _{G(TOT)}	V _{GS} = 10 V, V _{DS} = 32 V, I _D = 40 A		125		nC
Threshold Gate Charge	Q _{G(TH)}			5.5		
Gate-to-Source Charge	Q _{GS}			12.5		
Gate-to-Drain Charge	Q _{GD}			55		

SWITCHING CHARACTERISTICS, V_{GS} = 10 V (Note 3)

Turn-On Delay Time	t _{d(ON)}	V _{GS} = 10 V, V _{DD} = 32 V, I _D = 40 A, R _G = 2.5 Ω		10		ns
Rise Time	t _r			65		
Turn-Off Delay Time	t _{d(OFF)}			85		
Fall Time	t _f			85		

SWITCHING CHARACTERISTICS, V_{GS} = 5 V (Note 3)

Turn-On Delay Time	t _{d(ON)}	V _{GS} = 5 V, V _{DD} = 20 V, I _D = 20 A, R _G = 2.5 Ω		25		ns
Rise Time	t _r			175		
Turn-Off Delay Time	t _{d(OFF)}			46		
Fall Time	t _f			62		

DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V _{SD}	V _{GS} = 0 V, I _S = 20 A	T _J = 25°C		0.8	1.1	V
			T _J = 125°C		0.65		
Reverse Recovery Time	t _{RR}	V _{GS} = 0 V, dI _{SD} /dt = 100 A/μs, I _S = 20 A			75		ns
Charge Time	t _a				38		
Discharge Time	t _b				38		
Reverse Recovery Charge	Q _{RR}				140		

2. Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%.
3. Switching characteristics are independent of operating junction temperatures.

TYPICAL PERFORMANCE CURVES

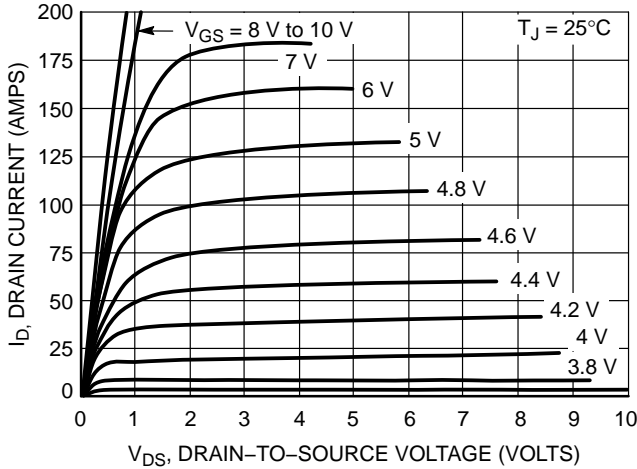


Figure 1. On-Region Characteristics

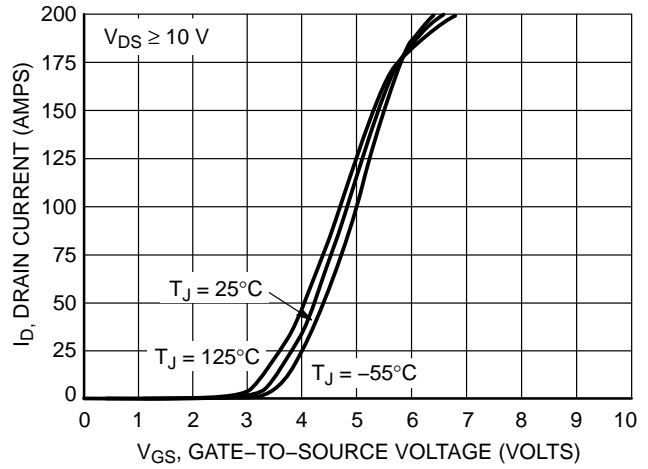


Figure 2. Transfer Characteristics

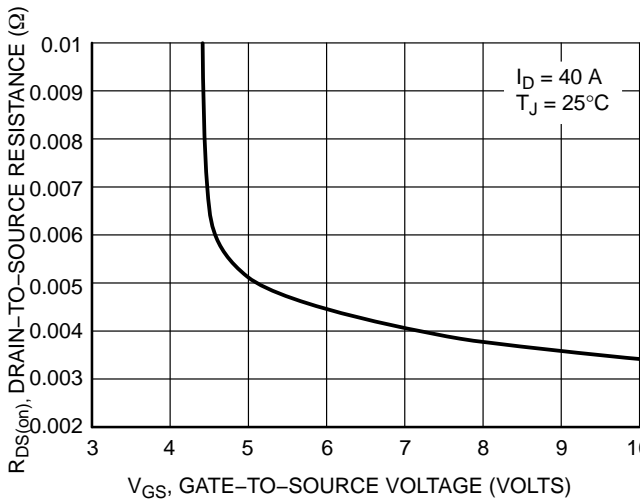


Figure 3. On-Resistance vs. Gate-to-Source Voltage

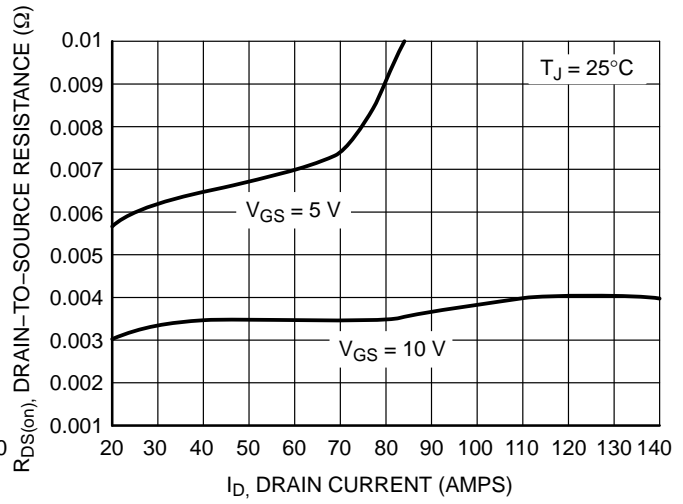


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

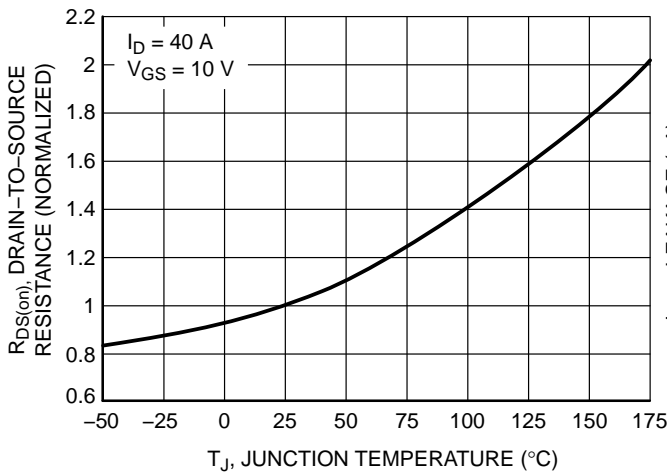


Figure 5. On-Resistance Variation with Temperature

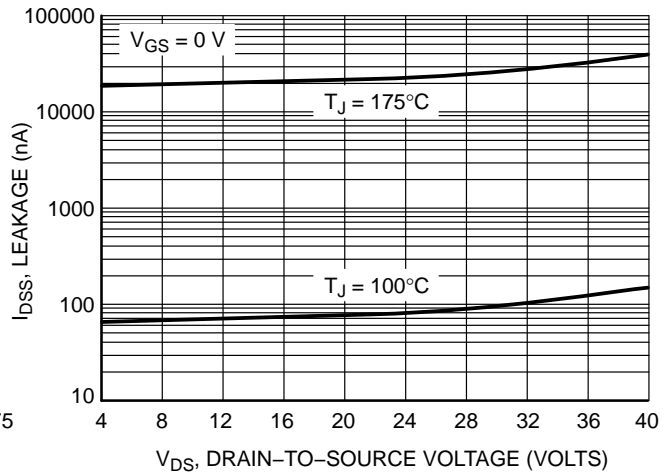


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL PERFORMANCE CURVES

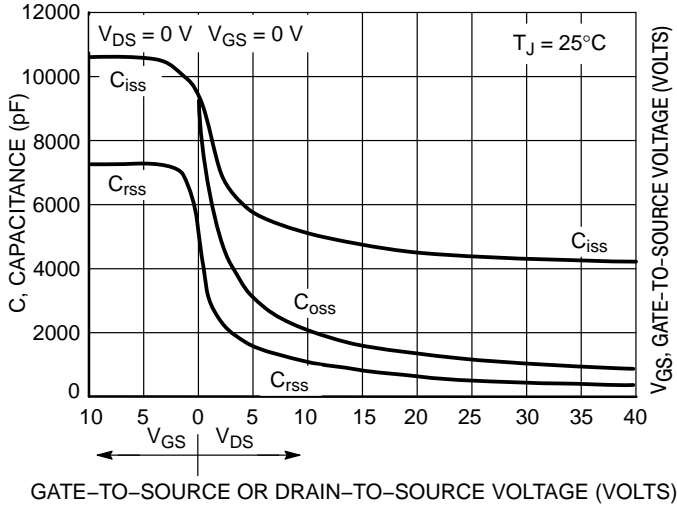


Figure 7. Capacitance Variation

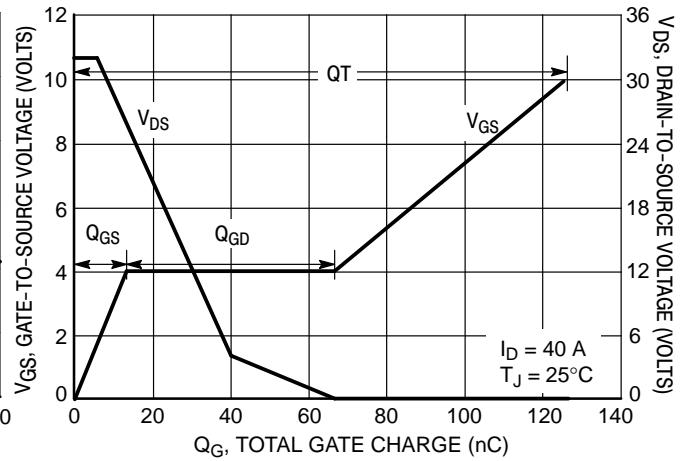


Figure 8. Gate-To-Source and Drain-To-Source Voltage vs. Total Charge

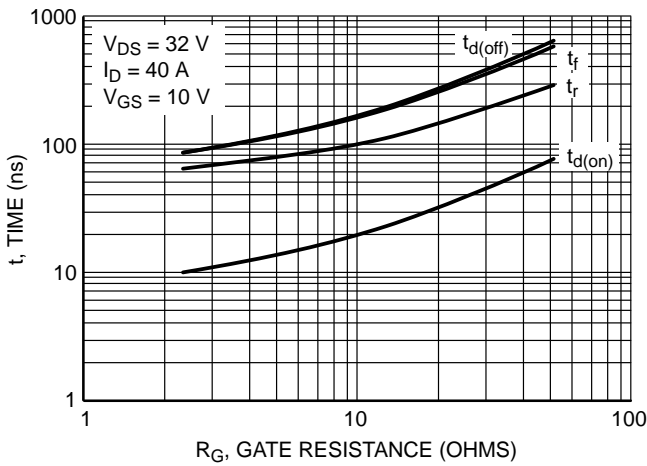


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

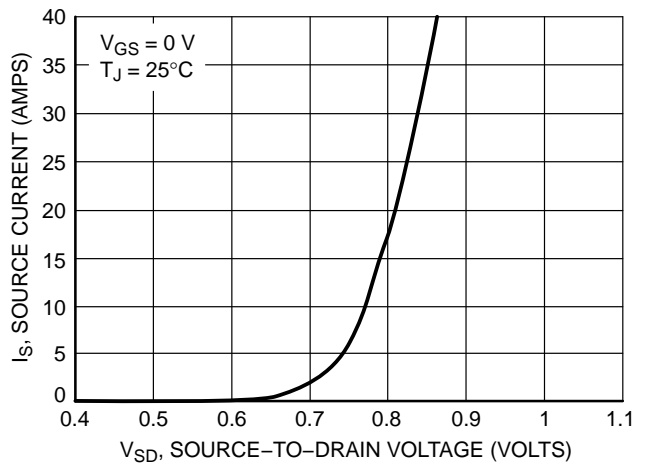


Figure 10. Diode Forward Voltage vs. Current

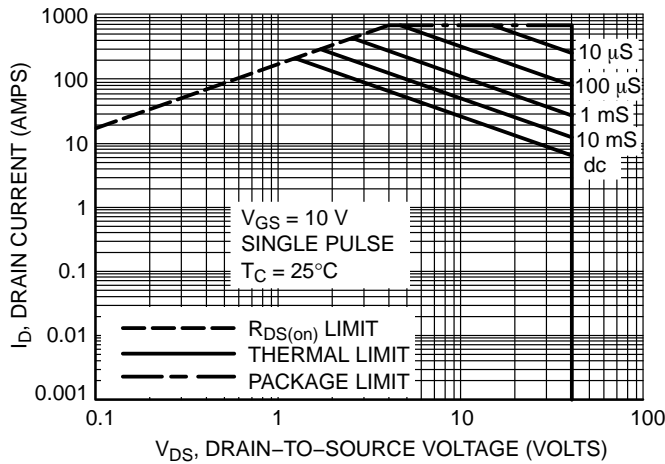


Figure 11. Maximum Rated Forward Biased Safe Operating Area

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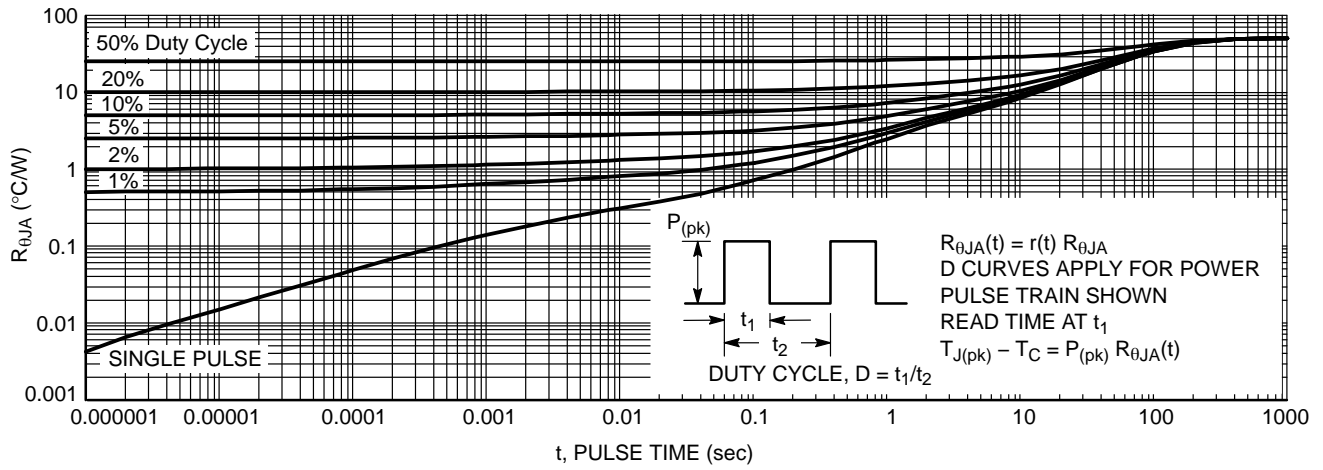
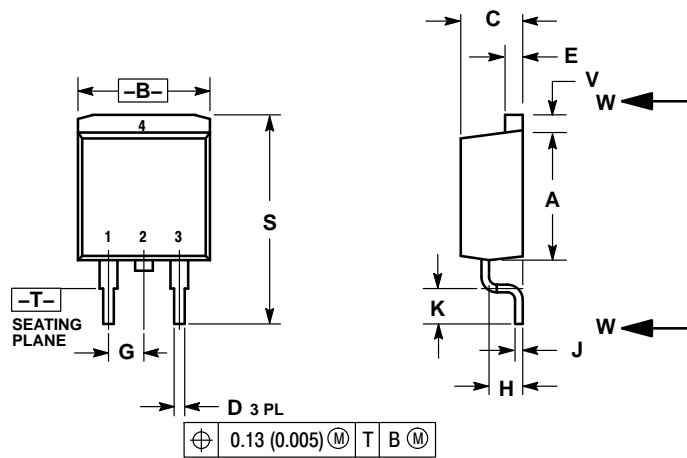


Figure 12. Thermal Response

NTB5404N, NTP5404N, NVB5404N

PACKAGE DIMENSIONS

D²PAK CASE 418B-04 ISSUE K



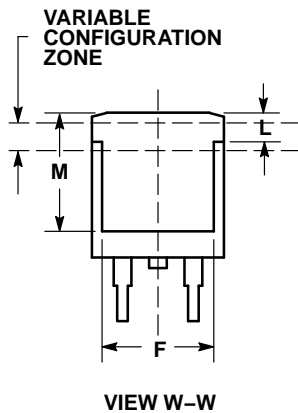
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 418B-01 THRU 418B-03 OBSOLETE, NEW STANDARD 418B-04.

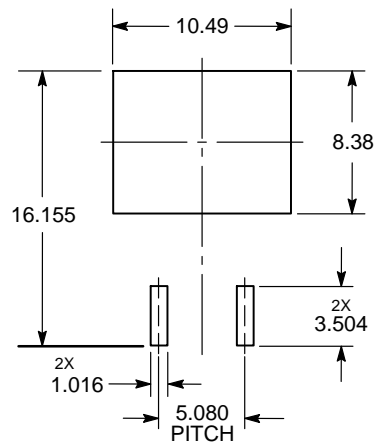
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.340	0.380	8.64	9.65
B	0.380	0.405	9.65	10.29
C	0.160	0.190	4.06	4.83
D	0.020	0.035	0.51	0.89
E	0.045	0.055	1.14	1.40
F	0.310	0.350	7.87	8.89
G	0.100 BSC		2.54 BSC	
H	0.080	0.110	2.03	2.79
J	0.018	0.025	0.46	0.64
K	0.090	0.110	2.29	2.79
L	0.052	0.072	1.32	1.83
M	0.280	0.320	7.11	8.13
N	0.197 REF		5.00 REF	
P	0.079 REF		2.00 REF	
R	0.039 REF		0.99 REF	
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



SOLDERING FOOTPRINT*



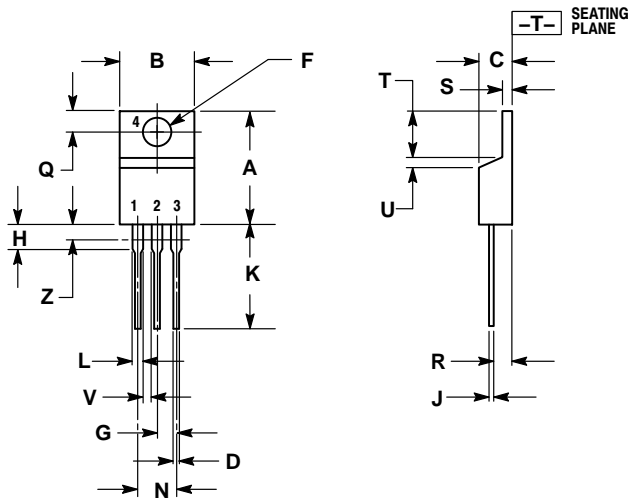
DIMENSIONS: MILLIMETERS

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NTB5404N, NTP5404N, NVB5404N

PACKAGE DIMENSIONS

TO-220
CASE 221A-09
ISSUE AH



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	0.415	9.66	10.53
C	0.160	0.190	4.07	4.83
D	0.025	0.038	0.64	0.96
F	0.142	0.161	3.61	4.09
G	0.095	0.105	2.42	2.66
H	0.110	0.161	2.80	4.10
J	0.014	0.024	0.36	0.61
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

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