

NTB5404N, NTP5404N

Power MOSFET

40 V, 136 A, Single N-Channel, D²PAK & TO-220

Features

- Low $R_{DS(on)}$
- High Current Capability
- Low Gate Charge
- This is a Pb-Free Device

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	I_D	$T_C = 25^\circ\text{C}$	136	A
			$T_C = 100^\circ\text{C}$	96	
Power Dissipation - $R_{\theta JC}$	Steady State	P_D	167	W	
Continuous Drain Current - $R_{\theta JA}$ (Note 1)	Steady State	I_D	$T_A = 25^\circ\text{C}$	24.2	A
			$T_A = 100^\circ\text{C}$	17	
Power Dissipation - $R_{\theta JA}$ (Note 1)	Steady State	P_D	5.3	W	
Pulsed Drain Current	$t_p = 10 \mu\text{s}$	I_{DM}	258	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 Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Case (Drain)	$R_{\theta JC}$	0.9	$^\circ\text{C/W}$
Junction-to-Ambient (Note 1)	$R_{\theta JA}$	28	$^\circ\text{C/W}$

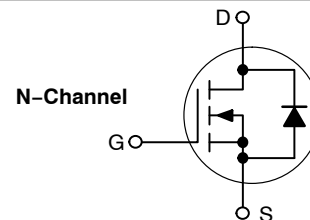
1. Surface mounted on FR4 board using 1 sq in pad size, (Cu Area 1.127 sq in [2 oz] including traces).



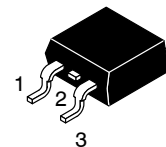
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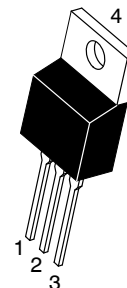
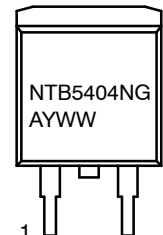
$V_{(BR)DSS}$	$R_{DS(ON)}$ TYP	I_D MAX (Note 1)
40 V	3.5 m Ω @ 10 V	136 A



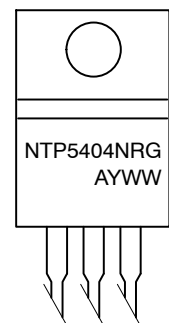
MARKING DIAGRAMS



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

†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.

NTB5404N, NTP5404N

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	40			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			34		mV/°C
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0\text{ V}, V_{DS} = 40\text{ V}$	$T_J = 25^\circ\text{C}$		1.0	μA
			$T_J = 100^\circ\text{C}$		10	
Gate-to-Source Leakage Current	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = \pm 30\text{ V}$			± 100	nA

ON CHARACTERISTICS (Note 2)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	1.5		3.5	V
Gate Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			-8.2		mV/°C
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 40\text{ A}$		3.5	4.5	m Ω
		$V_{GS} = 5.0\text{ V}, I_D = 15\text{ A}$		5.1	7.0	
Forward Transconductance	g_{FS}	$V_{DS} = 10\text{ V}, I_D = 15\text{ A}$		35		S

CHARGES AND CAPACITANCES

Input Capacitance	C_{ISS}	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 32\text{ V}$		4300	7000	pF
Output Capacitance	C_{OSS}			1075	1700	
Reverse Transfer Capacitance	C_{RSS}			450	1000	
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 10\text{ V}, V_{DS} = 32\text{ V}, I_D = 40\text{ A}$		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, $V_{GS} = 10\text{ V}$ (Note 3)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 10\text{ V}, V_{DD} = 32\text{ V}, I_D = 40\text{ A}, R_G = 2.5\ \Omega$		10		ns
Rise Time	t_r			65		
Turn-Off Delay Time	$t_{d(OFF)}$			85		
Fall Time	t_f			85		

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

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 5\text{ V}, V_{DD} = 20\text{ V}, I_D = 20\text{ A}, R_G = 2.5\ \Omega$		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}	$V_{GS} = 0\text{ V}, I_S = 20\text{ A}$	$T_J = 25^\circ\text{C}$		0.8	1.1	V
			$T_J = 125^\circ\text{C}$		0.65		
Reverse Recovery Time	t_{RR}	$V_{GS} = 0\text{ V}, dI_{SD}/dt = 100\text{ A}/\mu\text{s}, I_S = 20\text{ A}$			75		ns
Charge Time	t_a				38		
Discharge Time	t_b				38		
Reverse Recovery Charge	Q_{RR}				140		

- Pulse Test: pulse width $\leq 300\ \mu\text{s}$, duty cycle $\leq 2\%$.
- Switching characteristics are independent of operating junction temperatures.

NTB5404N, NTP5404N

TYPICAL PERFORMANCE CURVES

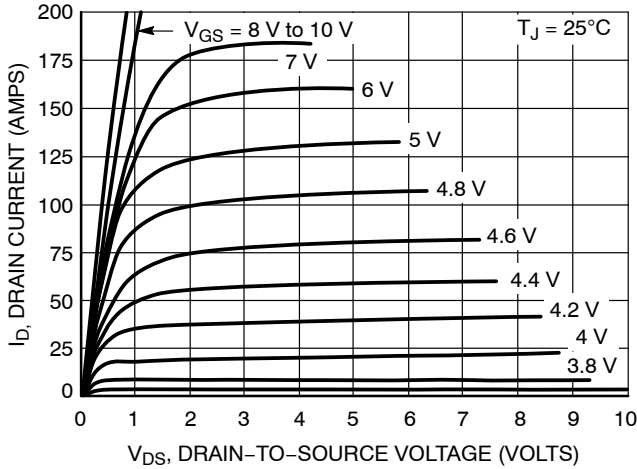


Figure 1. On-Region Characteristics

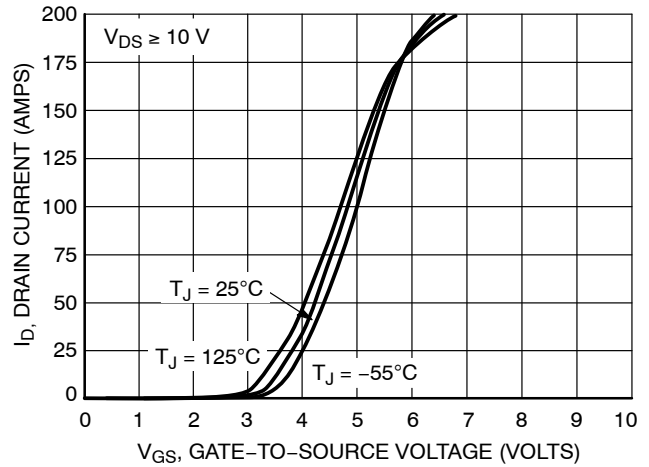


Figure 2. Transfer Characteristics

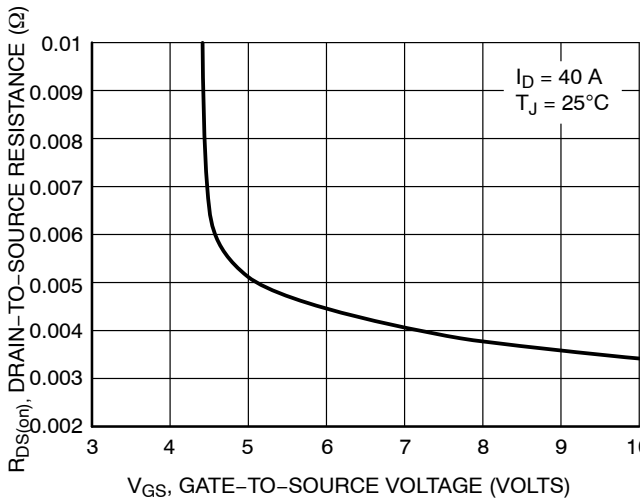


Figure 3. On-Resistance vs. Gate-to-Source Voltage

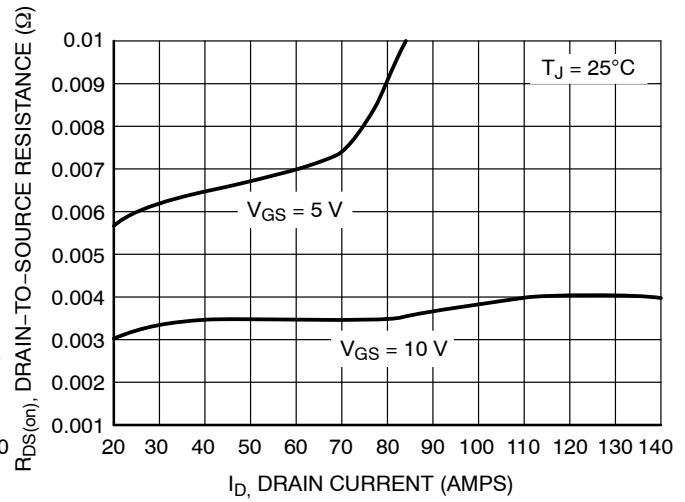


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

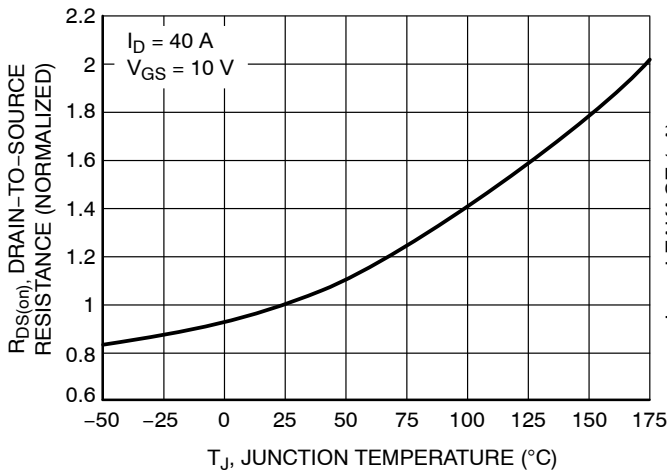


Figure 5. On-Resistance Variation with Temperature

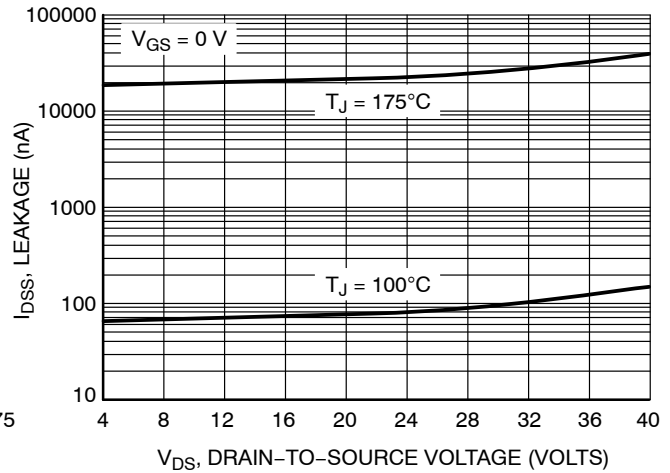


Figure 6. Drain-to-Source Leakage Current vs. Voltage

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TYPICAL PERFORMANCE CURVES

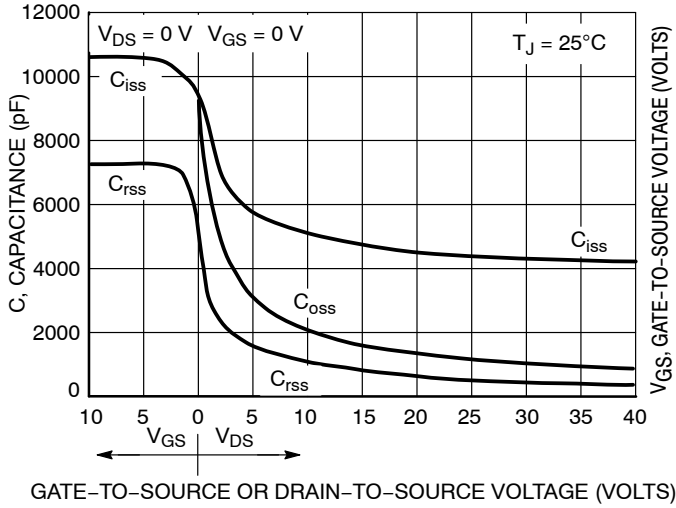


Figure 7. Capacitance Variation

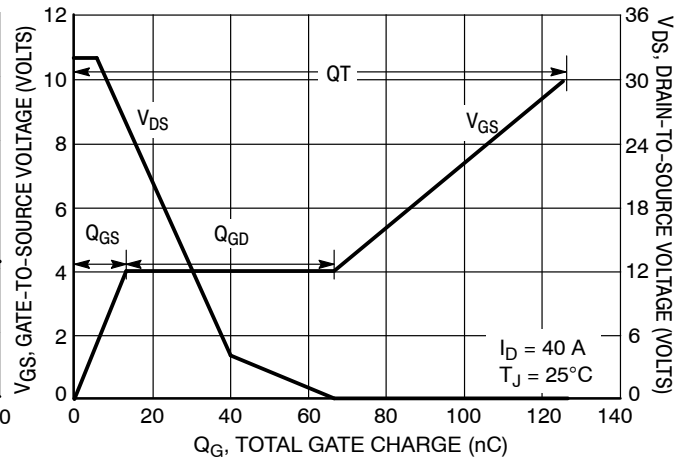


Figure 8. Gate-To-Source and Drain-To-Source Voltage vs. Total Charge

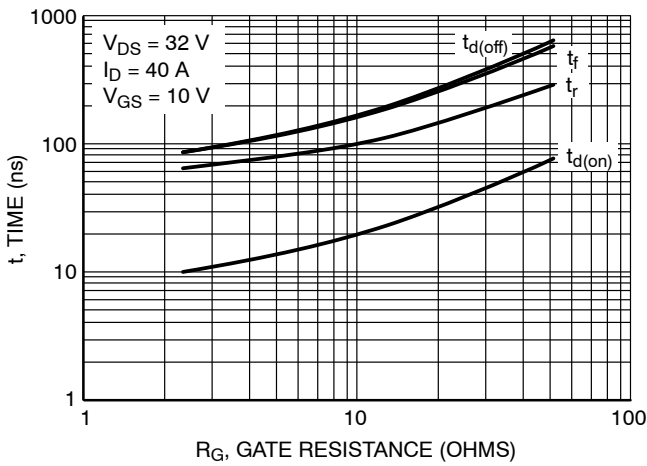


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

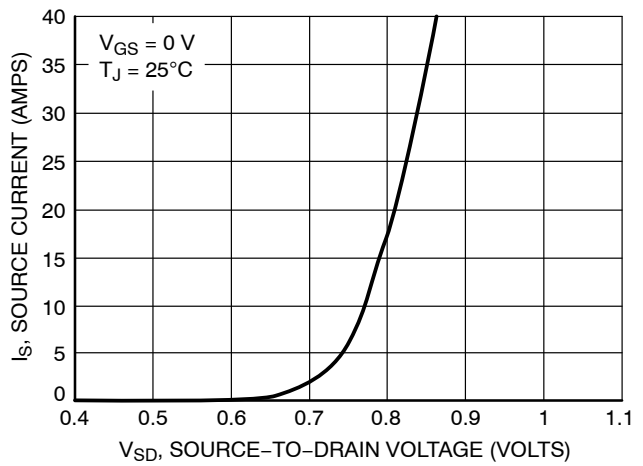


Figure 10. Diode Forward Voltage vs. Current

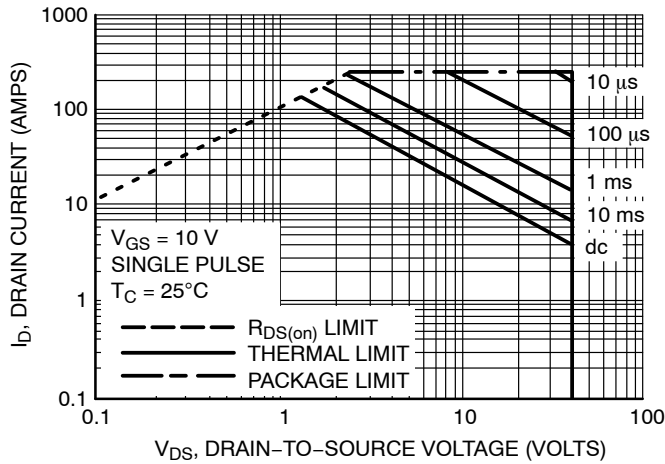


Figure 11. Maximum Rated Forward Biased Safe Operating Area

NTB5404N, NTP5404N

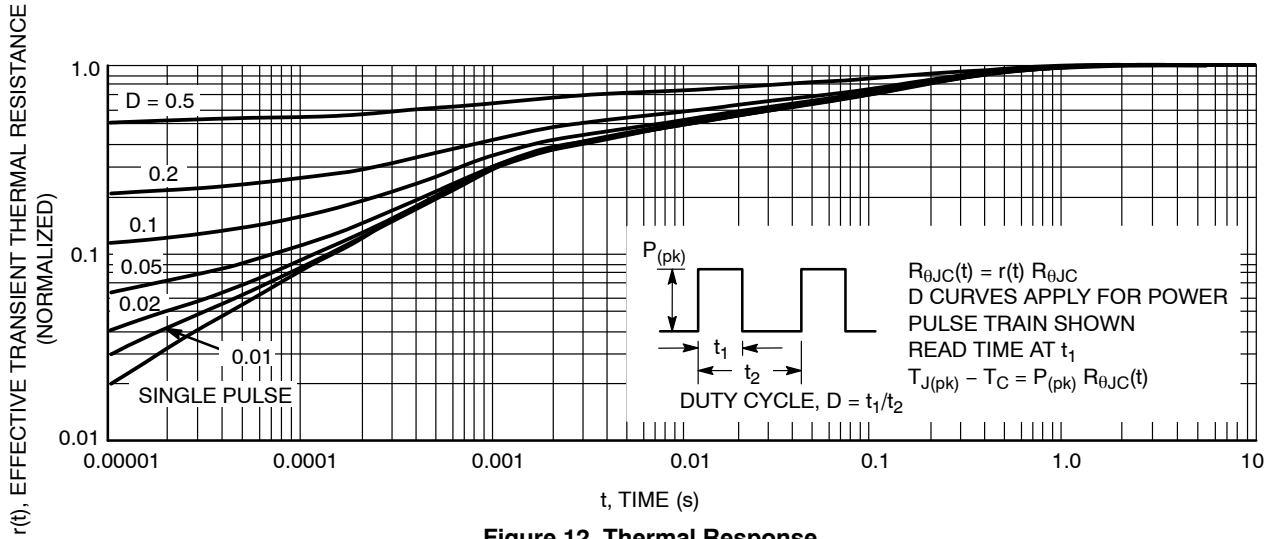
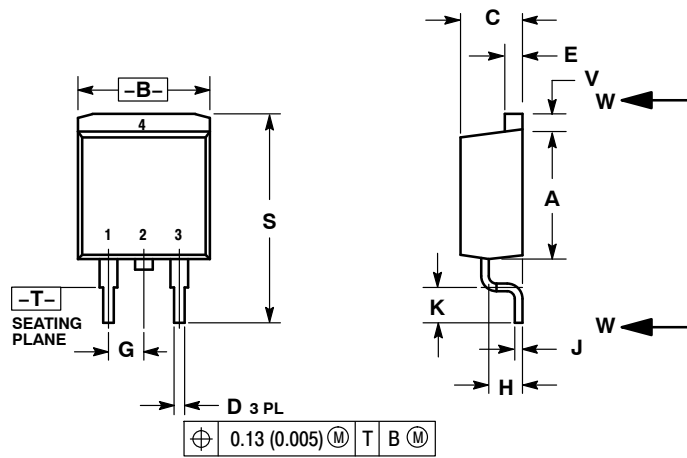


Figure 12. Thermal Response

NTB5404N, NTP5404N

PACKAGE DIMENSIONS

D²PAK
CASE 418B-04
ISSUE K



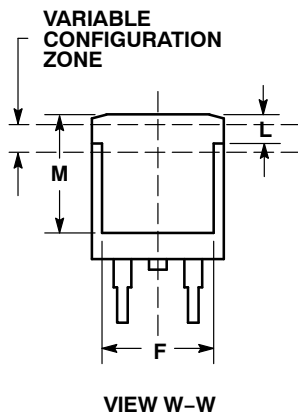
NOTES:

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

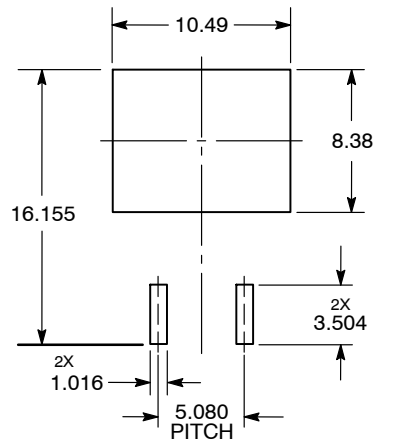
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.340	0.380	8.64	9.65
B	0.380	0.405	9.65	10.29
C	0.160	0.190	4.06	4.83
D	0.020	0.035	0.51	0.89
E	0.045	0.055	1.14	1.40
F	0.310	0.350	7.87	8.89
G	0.100 BSC		2.54 BSC	
H	0.080	0.110	2.03	2.79
J	0.018	0.025	0.46	0.64
K	0.090	0.110	2.29	2.79
L	0.052	0.072	1.32	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:

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



SOLDERING FOOTPRINT*



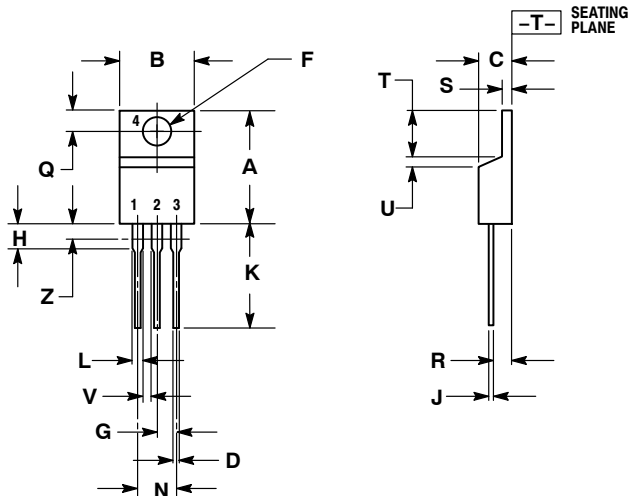
DIMENSIONS: MILLIMETERS

*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

PACKAGE DIMENSIONS

TO-220
CASE 221A-09
ISSUE AF



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	0.161	3.61	4.09
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.014	0.025	0.36	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

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