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NTB5860N, NTP5860N, NVB5860N

N-Channel Power MOSFET

60 V, 220 A, 3.0 mΩ



ON Semiconductor®

<http://onsemi.com>

Features

- Low $R_{DS(on)}$
- High Current Capability
- 100% Avalanche Tested
- These Devices are Pb-Free, Halogen Free and are RoHS Compliant
- NVB Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable

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

Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	V_{DSS}	60	V
Gate-to-Source Voltage – Continuous	V_{GS}	± 20	V
Continuous Drain Current, $R_{\theta JC}$	I_D	$T_C = 25^\circ\text{C}$	220
		$T_C = 100^\circ\text{C}$	156
Power Dissipation, $R_{\theta JC}$	P_D	283	W
Pulsed Drain Current	$t_p = 10 \mu\text{s}$	I_{DM}	660
Current Limited by Package	I_{DMmax}	130	A
Operating and Storage Temperature Range	T_J, T_{stg}	-55 to +175	$^\circ\text{C}$
Source Current (Body Diode)	I_S	130	A
Single Pulse Drain-to-Source Avalanche Energy ($L = 0.3 \text{ mH}$)	E_{AS}	735	mJ
Lead Temperature for Soldering Purposes (1/8" from Case for 10 Seconds)	T_L	260	$^\circ\text{C}$

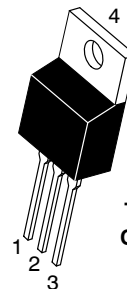
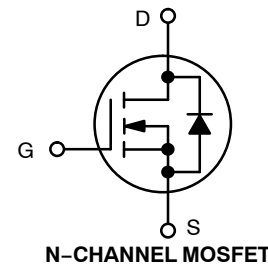
THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Case (Drain) Steady State	$R_{\theta JC}$	0.53	$^\circ\text{C}/\text{W}$
Junction-to-Ambient – Steady State (Note 1)	$R_{\theta JA}$	28	

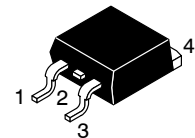
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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

$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	I_D MAX
60 V	3.0 mΩ @ 10 V	220 A

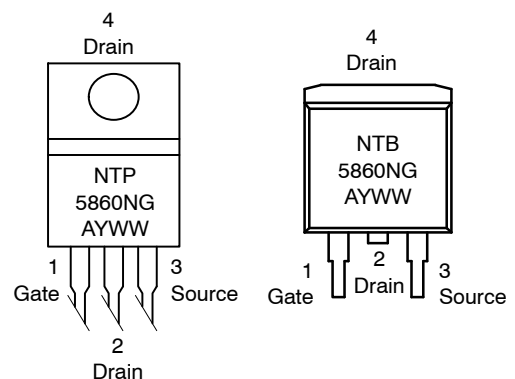


TO-220AB
CASE 221A
STYLE 5



D²PAK
CASE 418B
STYLE 2

MARKING DIAGRAMS & PIN ASSIGNMENTS



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

*Could be one or two digit alpha or numeric code

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

NTB5860N, NTP5860N, NVB5860N

ELECTRICAL CHARACTERISTICS (T_J = 25°C Unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Drain-to-Source Breakdown Voltage	V _{(BR)DSS}	V _{DS} = 0 V, I _D = 250 μA	60			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	V _{(BR)DSS} /T _J	I _D = 250 μA		5.0		mV/°C
Zero Gate Voltage Drain Current	I _{DSS}	V _{GS} = 0 V V _{DS} = 60 V	T _J = 25°C		1.0	μA
			T _J = 125°C		100	
Gate-Source Leakage Current	I _{GSS}	V _{DS} = 0 V, V _{GS} = ±20 V			±100	nA

ON CHARACTERISTICS (Note 2)

Gate Threshold Voltage	V _{GS(th)}	V _{GS} = V _{DS} , I _D = 250 μA	2.0		4.0	V
Threshold Temperature Coefficient	V _{GS(th)} /T _J			-10.1		mV/°C
Drain-to-Source On-Resistance	R _{DS(on)}	V _{GS} = 10 V, I _D = 75 A		2.5	3.0	mΩ
Forward Transconductance	g _{FS}	V _{DS} = 15 V, I _D = 30 A		38		S

CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	C _{iss}	V _{DS} = 25 V, V _{GS} = 0 V, f = 1 MHz		10760		pF
Output Capacitance	C _{oss}			1125		
Transfer Capacitance	C _{rss}			700		
Total Gate Charge	Q _{G(TOT)}	V _{GS} = 10 V, V _{DS} = 48 V, I _D = 65 A		180		nC
Threshold Gate Charge	Q _{G(TH)}			11		
Gate-to-Source Charge	Q _{GS}			45		
Gate-to-Drain Charge	Q _{GD}			57		

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

Turn-On Delay Time	t _{d(on)}	V _{GS} = 10 V, V _{DD} = 48 V, I _D = 65 A, R _G = 2.5 Ω		27		ns
Rise Time	t _r			117		
Turn-Off Delay Time	t _{d(off)}			66		
Fall Time	t _f			150		

DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V _{SD}	V _{GS} = 0 V I _S = 20 A	T _J = 25°C		0.76	1.1	V _{dc}
			T _J = 125°C		0.63		
Reverse Recovery Time	t _{rr}	V _{GS} = 0 V, I _S = 65 A, di _S /dt = 100 A/μs		55		ns	
Charge Time	t _a			29			
Discharge Time	t _b			26			
Reverse Recovery Stored Charge	Q _{RR}			76			nC

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

TYPICAL CHARACTERISTICS

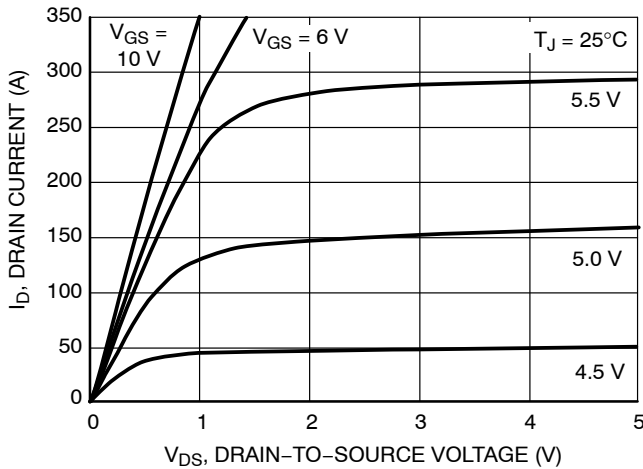


Figure 1. On-Region Characteristics

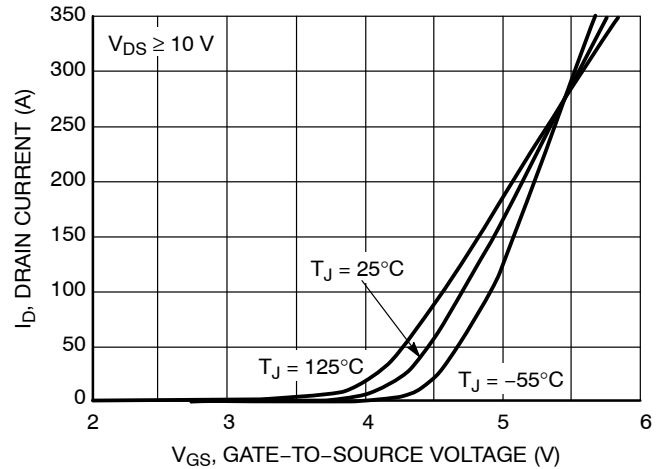


Figure 2. Transfer Characteristics

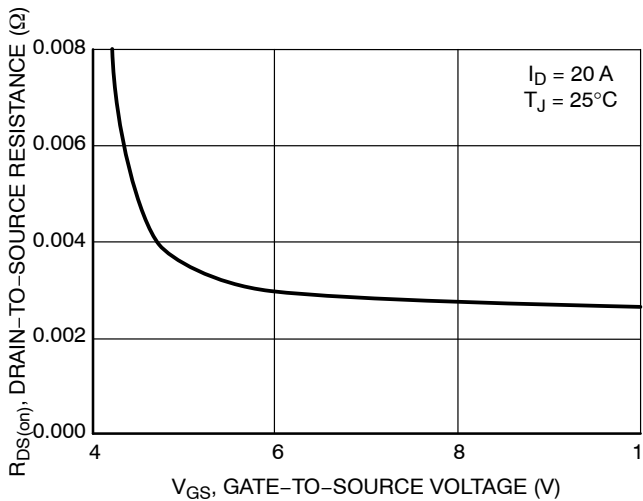


Figure 3. On-Resistance vs. Gate Voltage

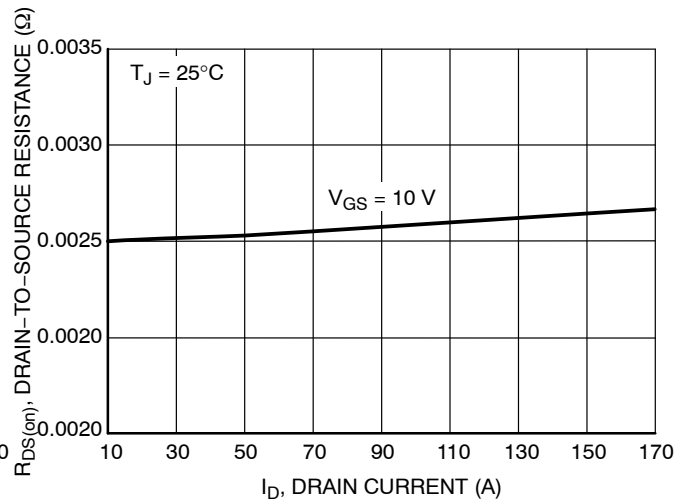


Figure 4. On-Resistance vs. Drain Current

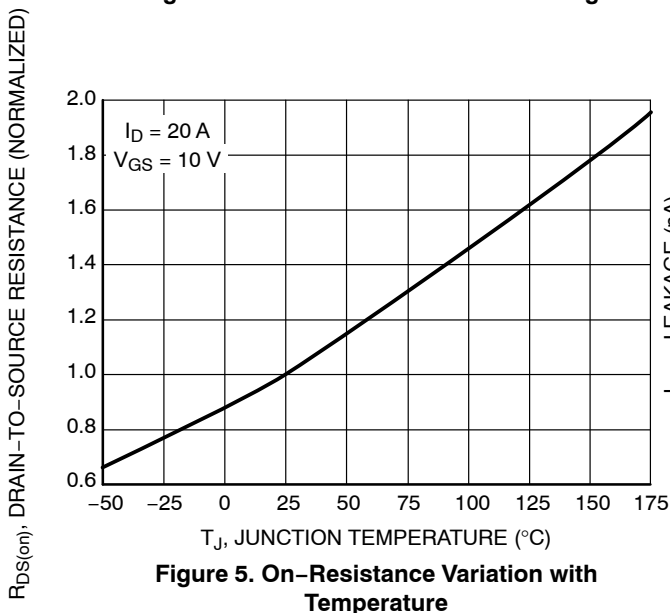


Figure 5. On-Resistance Variation with Temperature

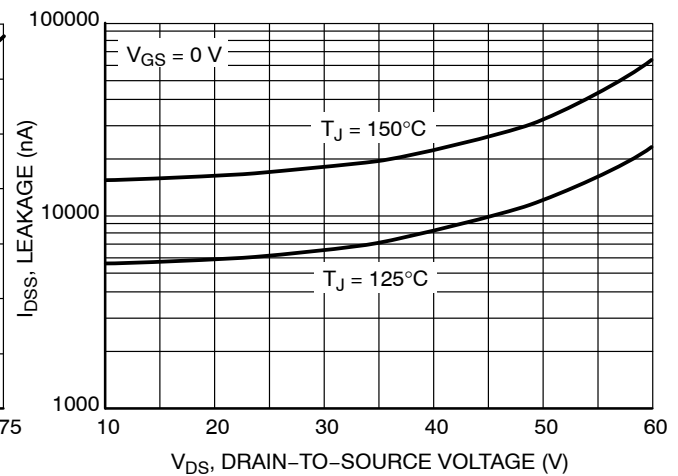


Figure 6. Drain-to-Source Leakage Current vs. Voltage

NTB5860N, NTP5860N, NVB5860N

TYPICAL CHARACTERISTICS

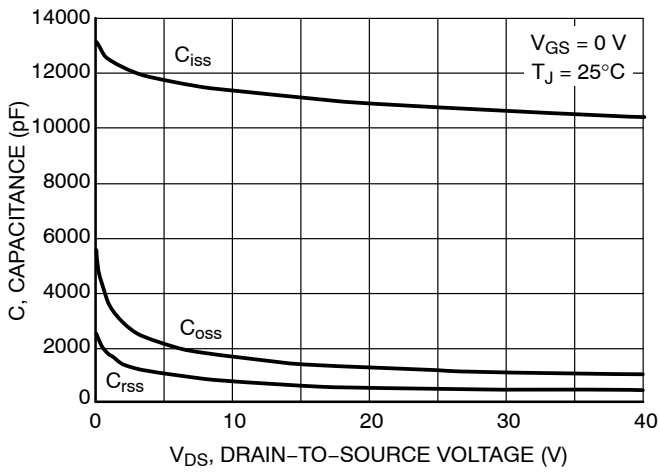


Figure 7. Capacitance Variation

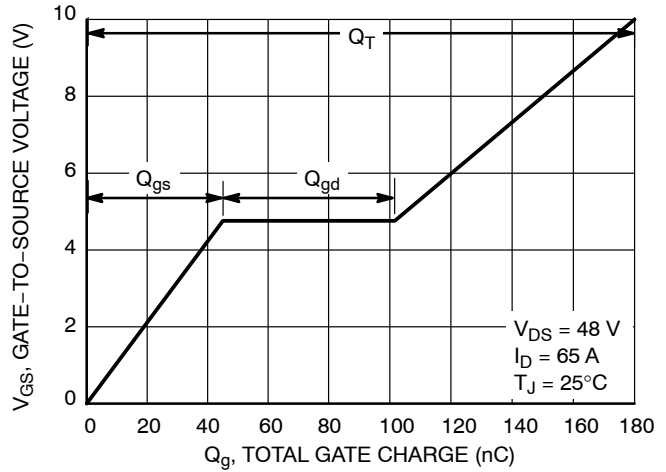


Figure 8. Gate-to-Source vs. Total Charge

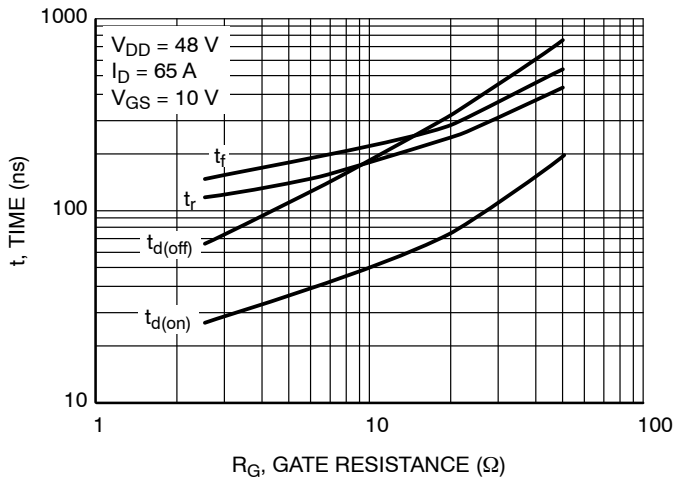


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

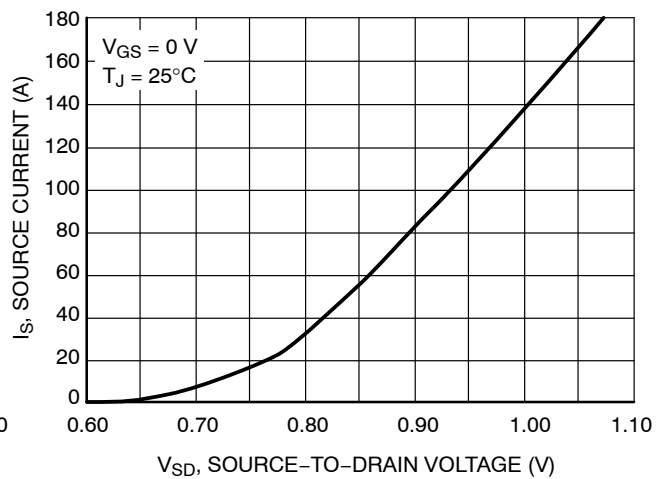


Figure 10. Diode Forward Voltage vs. Current

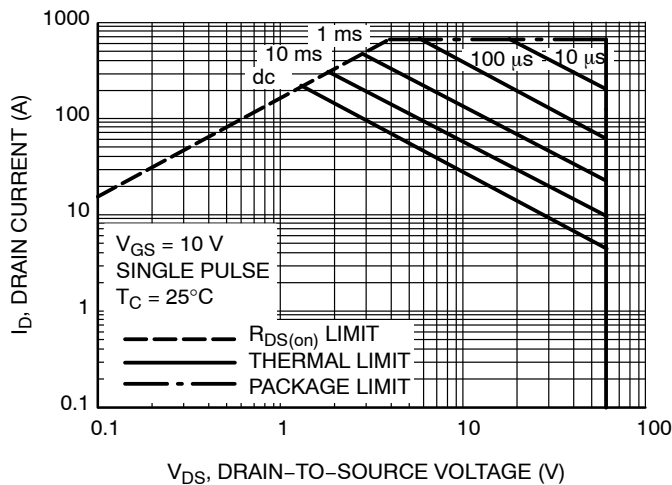


Figure 11. Maximum Rated Forward Biased Safe Operating Area

NTB5860N, NTP5860N, NVB5860N

TYPICAL CHARACTERISTICS

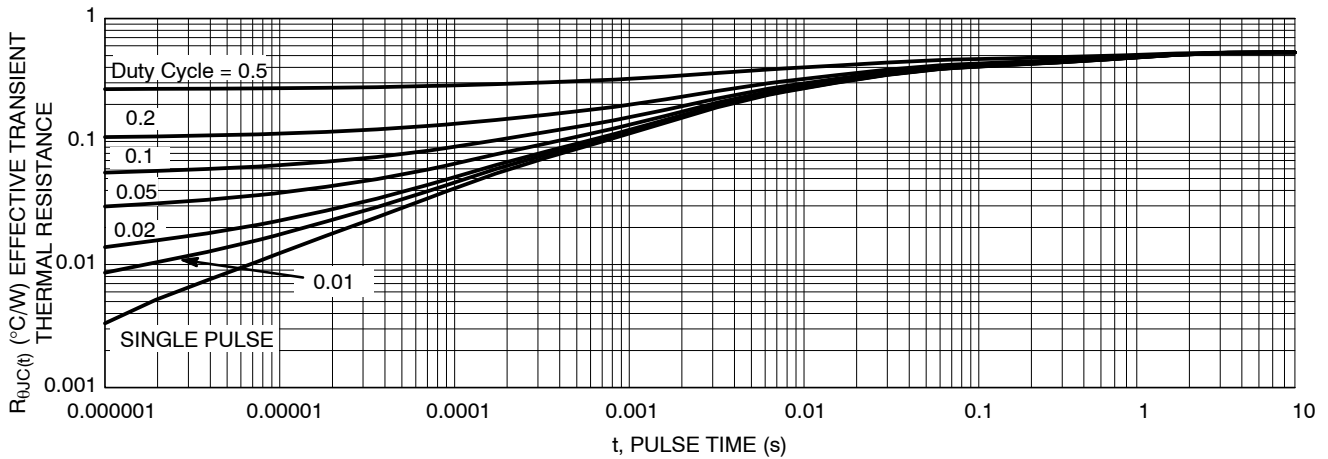


Figure 12. Thermal Response

ORDERING INFORMATION

Device	Package	Shipping†
NTP5860NG	TO-220AB (Pb-Free)	50 Units / Rail
NTB5860NT4G	D ² PAK (Pb-Free)	800 / Tape & Reel
NVB5860NT4G*	D ² PAK (Pb-Free)	800 / Tape & Reel

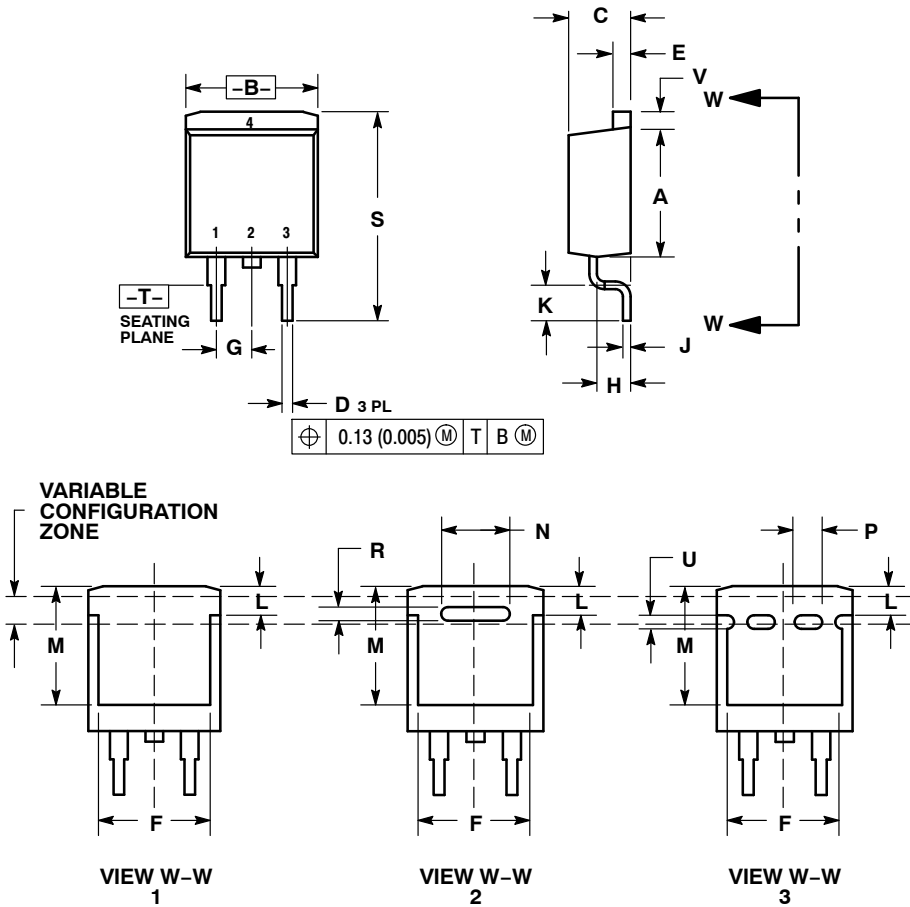
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

*NVB Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.

NTB5860N, NTP5860N, NVB5860N

PACKAGE DIMENSIONS

D²PAK
CASE 418B-04
ISSUE J



NOTES:

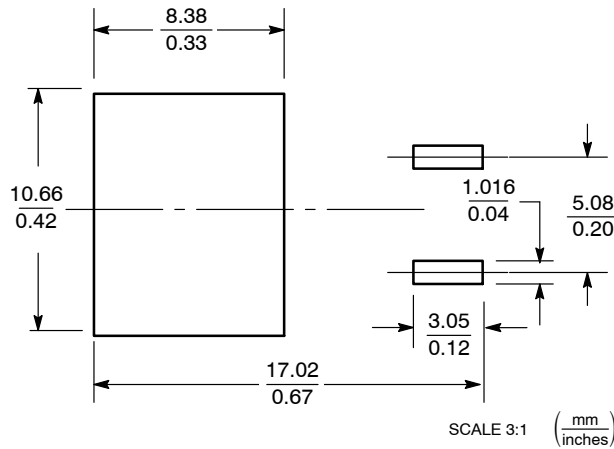
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 418B-01 THRU 418B-03 OBSOLETE, NEW STANDARD 418B-04.

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*

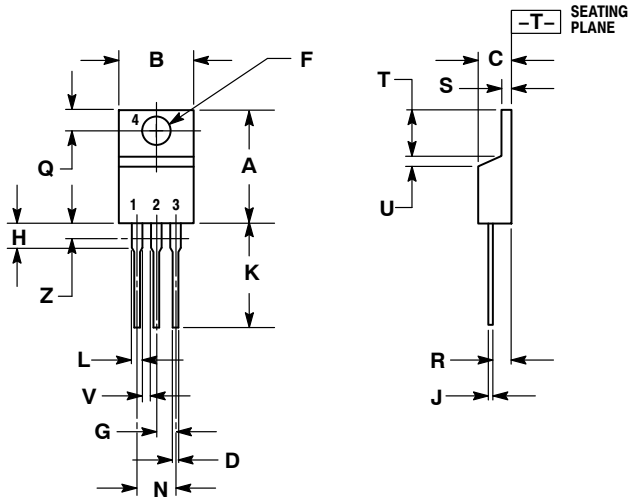


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NTB5860N, NTP5860N, NVB5860N

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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