NTB5412N, NTP5412N

Power MOSFET
60 Amps, 60 Volts
N-Channel D²PAK, TO-220

ON Semiconductor®

http://onsemi.com

Features

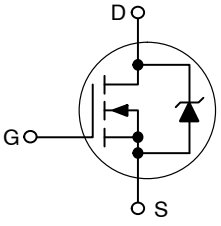
- Low $R_{DS(on)}$
- High Current Capability
- Avalanche Energy Specified
- These are Pb−Free Devices

Applications

- LED Lighting and LED Backlight Drivers
- DC−DC Converters
- DC Motor Drivers
- Power Supplies Secondary Side Synchronous Rectification

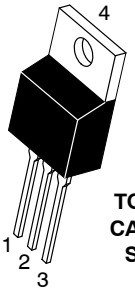
$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	I_D MAX (Note 1)
60 V	14 mΩ @ 10 V	60 A

N−Channel

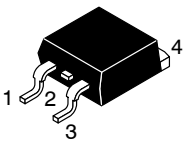


MAXIMUM RATINGS (T_J = 25°C Unless otherwise specified)

Parameter			Symbol	Value	Unit
Drain−to−Source Voltage			V_{DSS}	60	V
Gate−to−Source Voltage − Continuous			V_{GS}	±20	V
Gate−to−Source Voltage − Nonrepetitive (T_P < 10 μs)			V_{GS}	±30	V
Continuous Drain Current $R_{\theta JC}$ (Note 1)	Steady State	T_C = 25°C	I_D	60	A
		T_C = 100°C		44	
Power Dissipation $R_{\theta JC}$ (Note 1)	Steady State	T_C = 25°C	P_D	125	W
Pulsed Drain Current	t_p = 10 μs		I_{DM}	155	A
Operating and Storage Temperature Range			T_J, T_{stg}	−55 to 175	°C
Source Current (Body Diode)			I_S	60	A
Single Pulse Drain−to−Source Avalanche Energy − Starting T_J = 25°C (V_{DD} = 50 V_{dc}, V_{GS} = 10 V_{dc}, $I_{L(pk)}$ = 60 A, L = 0.1 mH, R_G = 25 Ω)			E_{AS}	180	mJ
Lead Temperature for Soldering Purposes, 1/8″ from Case for 10 Seconds			T_L	260	°C



TO−220AB
CASE 221A
STYLE 5



D²PAK
CASE 418B
STYLE 2

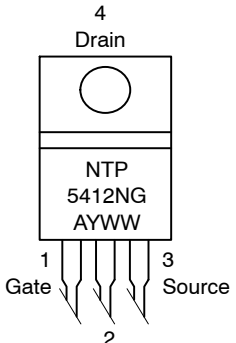
THERMAL RESISTANCE RATINGS

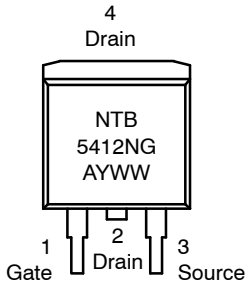
Parameter	Symbol	Max	Unit
Junction−to−Case (Drain) Steady State (Note 1)	$R_{\theta JC}$	1.2	°C/W
	$R_{\theta JA}$	43.2	

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 [1 oz] including traces).

MARKING DIAGRAM & PIN ASSIGNMENT





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

ORDERING INFORMATION

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

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	$V_{(BR)DSS}/T_J$				54.6		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 = 150°C			100	
Gate−Body 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	3.3	4.0	V
Negative Threshold Temperature Coefficient	$V_{GS(th)}/T_J$				6.4		mV/°C
Drain−to−Source On Voltage	$V_{DS(on)}$	V_{GS} = 10 V, I_D = 60 A			0.7	1.2	V
		V_{GS} = 10 V, I_D = 30 A, 150°C			0.75		
Static Drain−to−Source On−Resistance	$R_{DS(on)}$	V_{GS} = 10 V, I_D = 30 A			11.1	14	mΩ
Forward Transconductance	g_{FS}	V_{GS} = 15 V, I_D = 30 A			58		S
CHARGES, CAPACITANCES & GATE RESISTANCE							
Input Capacitance	C_{iss}	V_{DS} = 25 V, V_{GS} = 0 V, f = 1 MHz			2325	3220	pF
Output Capacitance	C_{oss}				440		
Transfer Capacitance	C_{rss}				170		
Total Gate Charge	$Q_{G(TOT)}$	V_{GS} = 0 V, V_{DS} = 48 V, I_D = 60 A			66	85	nC
Threshold Gate Charge	$Q_{G(TH)}$				2.8		
Gate−to−Source Charge	Q_{GS}				13.4		
Gate−to−Drain Charge	Q_{GD}				31		
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 = 60 A, R_G = 2.5 Ω			14		ns
Rise Time	t_r				115		
Turn−Off Delay Time	$t_{d(off)}$				41		
Fall Time	t_f				89		
DRAIN−SOURCE DIODE CHARACTERISTICS							
Forward Diode Voltage	V_{SD}	V_{GS} = 0 V, I_S = 60 A	T_J = 25°C		1.0	1.2	V_{dc}
			T_J = 125°C		0.9		
Reverse Recovery Time	t_{rr}	I_S = 60 A_{dc}, V_{GS} = 0 V_{dc}, dI_S/dt = 100 A/μs			75		ns
Charge Time	t_a				54		
Discharge Time	t_b				21		
Reverse Recovery Stored Charge	Q_{RR}				96		nC

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

TYPICAL PERFORMANCE CURVES

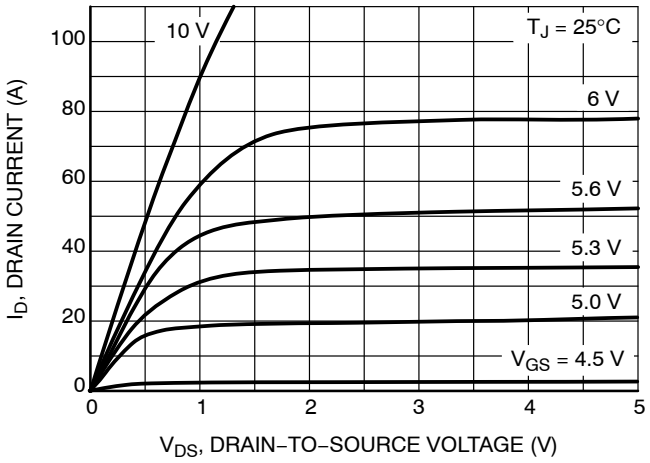


Figure 1. On−Region Characteristics

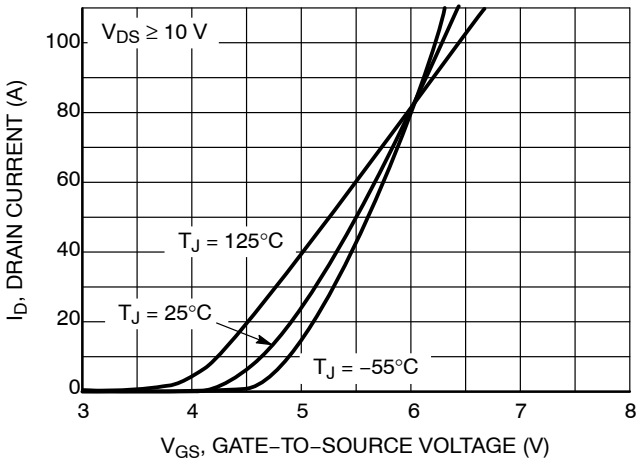


Figure 2. Transfer Characteristics

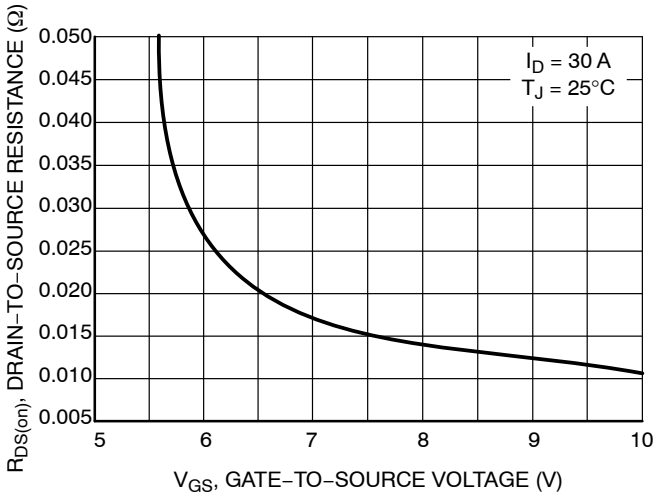


Figure 3. On−Resistance vs. Gate−to−Source Voltage

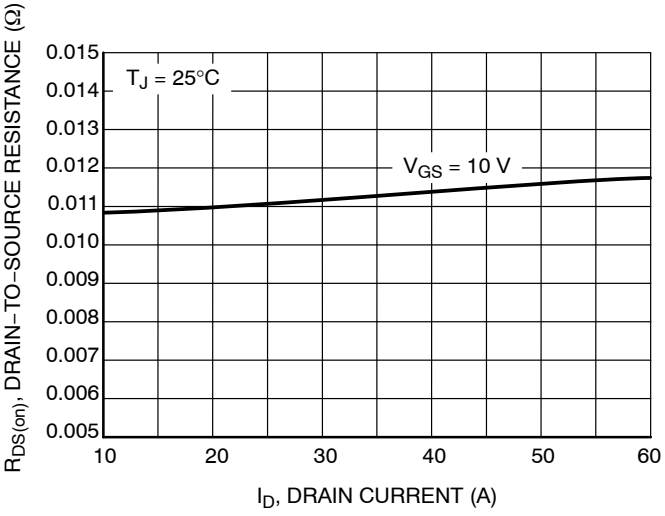


Figure 4. On−Resistance vs. Drain Current and Gate Voltage

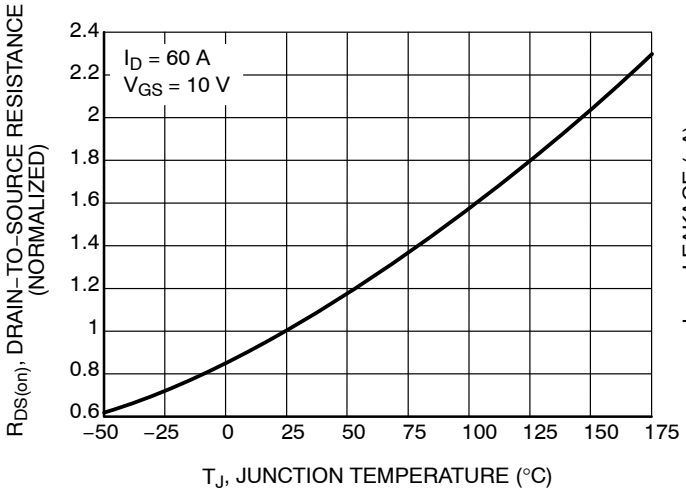


Figure 5. On−Resistance Variation with Temperature

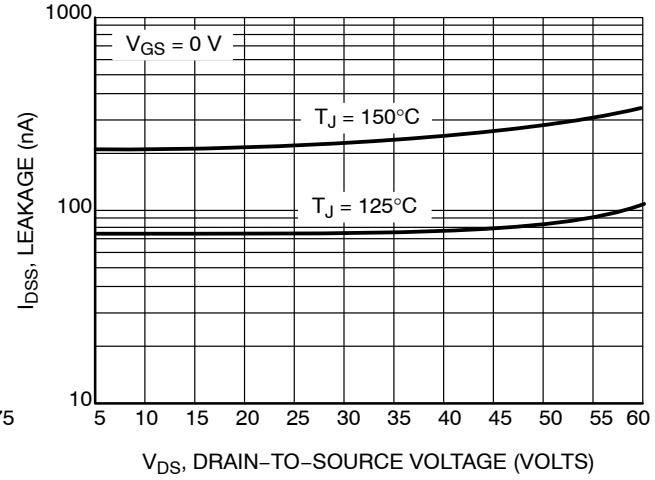


Figure 6. Drain−to−Source Leakage Current vs. Voltage

TYPICAL PERFORMANCE CURVES

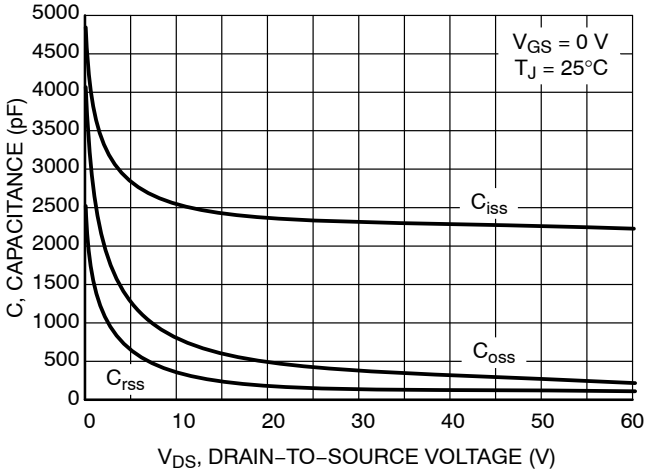


Figure 7. Capacitance Variation

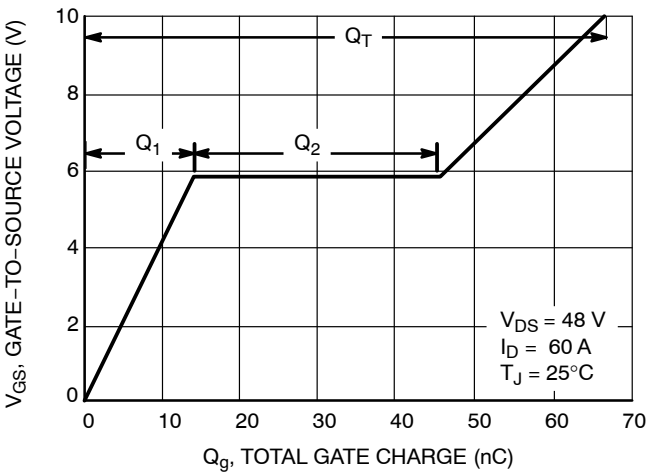


Figure 8. Gate−to−Source Voltage vs. Total Charge

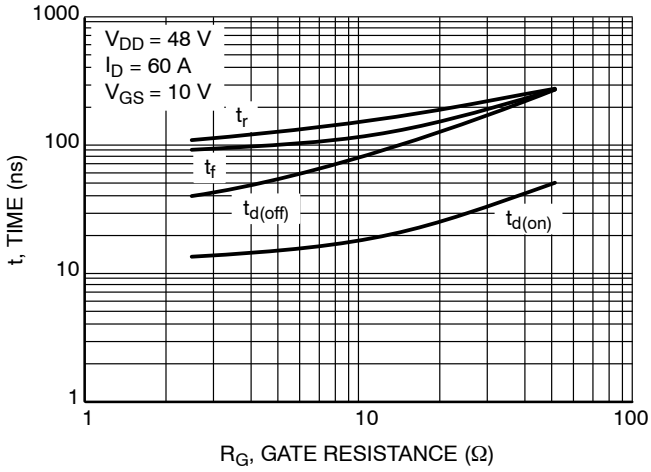


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

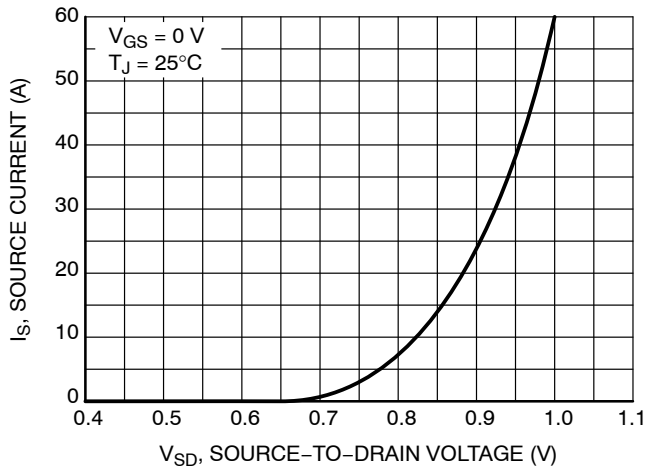


Figure 10. Diode Forward Voltage vs. Current

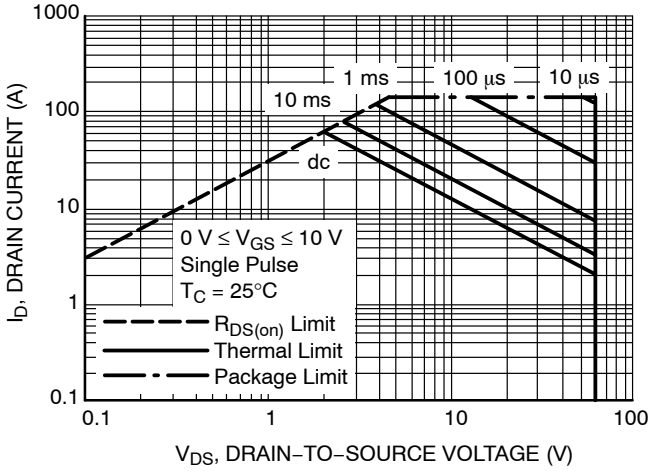


Figure 11. Maximum Rated Forward Biased Safe Operating Area

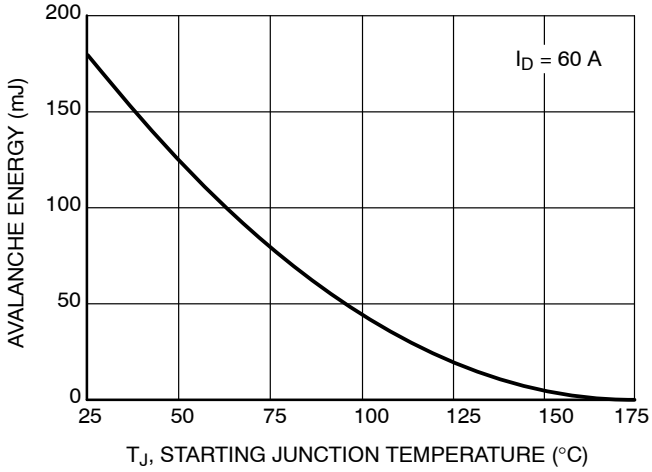


Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature

TYPICAL PERFORMANCE CURVES

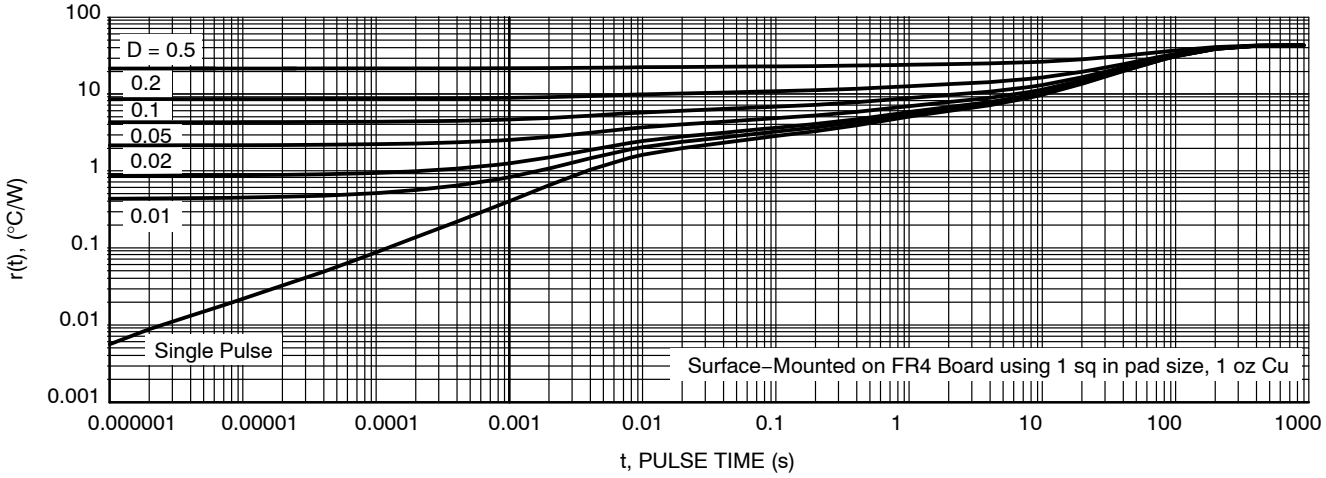


Figure 13. Thermal Response

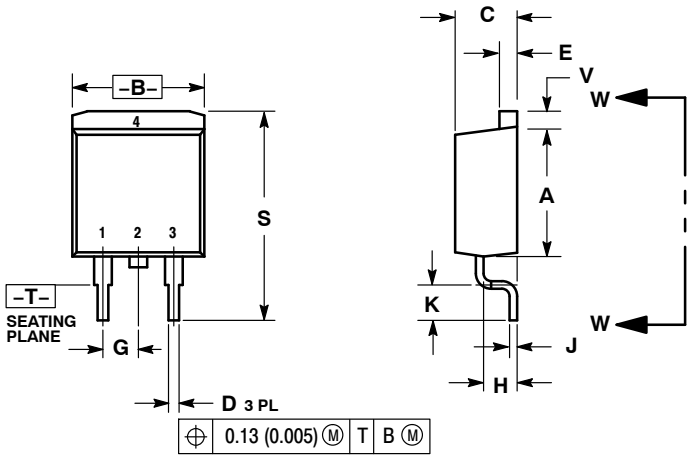
ORDERING INFORMATION

Device	Package	Shipping†
NTP5412NG	TO−220AB (Pb−Free)	50 Units / Rail
NTB5412NT4G	D^2PAK (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.

PACKAGE DIMENSIONS

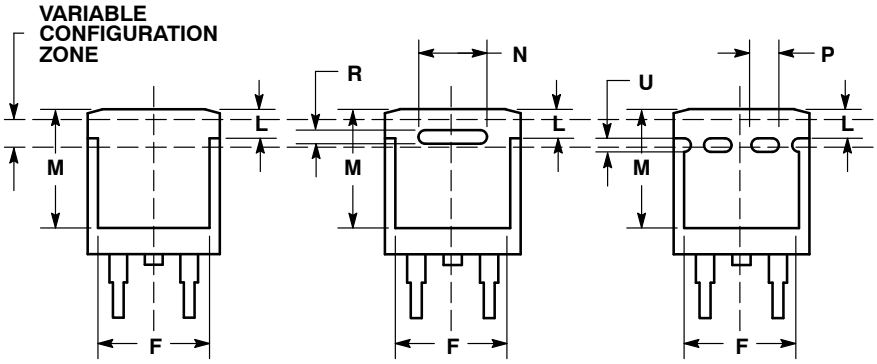
D²PAK 3
CASE 418B−04
ISSUE K



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.

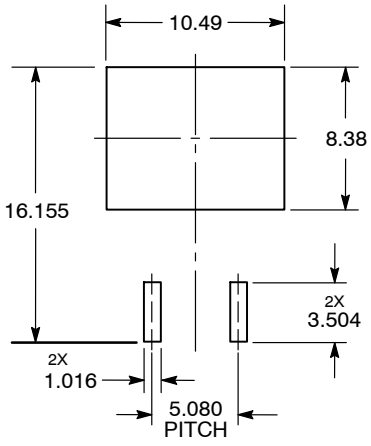
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.340	0.380	8.64	9.65
B	0.380	0.405	9.65	10.29
C	0.160	0.190	4.06	4.83
D	0.020	0.035	0.51	0.89
E	0.045	0.055	1.14	1.40
F	0.310	0.350	7.87	8.89
G	0.100 BSC		2.54 BSC	
H	0.080	0.110	2.03	2.79
J	0.018	0.025	0.46	0.64
K	0.090	0.110	2.29	2.79
L	0.052	0.072	1.32	1.83
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
2. DRAIN
3. SOURCE
4. DRAIN



VIEW W−W 1 | VIEW W−W 2 | VIEW W−W 3

SOLDERING FOOTPRINT*

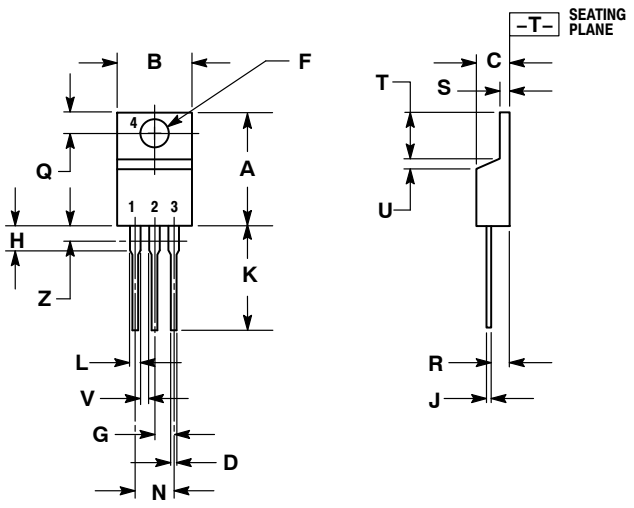


DIMENSIONS: MILLIMETERS

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

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.

	INCHES		MILLIMETERS	
DIM	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

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
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NTB5412N/D