

NTB5412N, NTP5412N

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

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

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	
Gate-to-Source Voltage – Nonrepetitive ($T_P < 10 \mu\text{s}$)	V_{GS}	± 30	V	
Continuous Drain Current $R_{\theta JC}$ (Note 1)	Steady State	$T_C = 25^\circ\text{C}$	I_D 60	A
		$T_C = 100^\circ\text{C}$	44	
Power Dissipation $R_{\theta JC}$ (Note 1)	Steady State	$T_C = 25^\circ\text{C}$	P_D 125	W
Pulsed Drain Current	$t_p = 10 \mu\text{s}$	I_{DM} 155	A	
Operating and Storage Temperature Range	T_J, T_{stg}	-55 to 175	$^\circ\text{C}$	
Source Current (Body Diode)	I_S	60	A	
Single Pulse Drain-to-Source Avalanche Energy – Starting $T_J = 25^\circ\text{C}$ ($V_{DD} = 50 \text{ V}_{dc}, V_{GS} = 10 \text{ V}_{dc}, I_{L(pk)} = 60 \text{ A}, L = 0.1 \text{ mH}, R_G = 25 \Omega$)	E_{AS}	180	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 (Note 1)	$R_{\theta JC}$	1.2	$^\circ\text{C/W}$
	$R_{\theta JA}$	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).

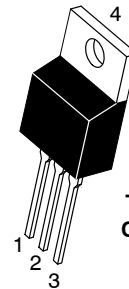
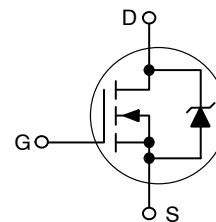


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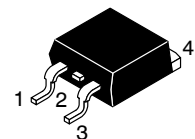
<http://onsemi.com>

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

N-Channel

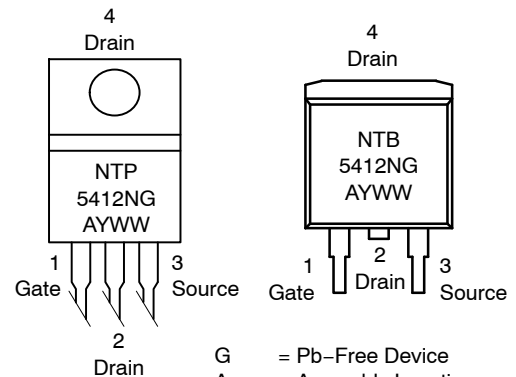


TO-220AB
CASE 221A
STYLE 5



D²PAK
CASE 418B
STYLE 2

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.

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

Characteristics	Symbol	Test Condition	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{DS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	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}	$V_{GS} = 0\text{ V}$ $V_{DS} = 60\text{ V}$	$T_J = 25^\circ\text{C}$		1.0	μA
			$T_J = 150^\circ\text{C}$		100	
Gate-Body Leakage Current	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			± 100	nA

ON CHARACTERISTICS (Note 2)

Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	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	$V_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 60\text{ A}$		0.7	1.2	V
		$V_{GS} = 10\text{ V}, I_D = 30\text{ A}, 150^\circ\text{C}$		0.75		
Static Drain-to-Source On-Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 30\text{ A}$		11.1	14	m Ω
Forward Transconductance	g_{FS}	$V_{GS} = 15\text{ V}, I_D = 30\text{ A}$		58		S

CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	C_{iss}	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$		2325	3220	pF
Output Capacitance	C_{oss}			440		
Transfer Capacitance	C_{rss}			170		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 0\text{ V}, V_{DS} = 48\text{ V},$ $I_D = 60\text{ A}$		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, $V_{GS} = 10\text{ V}$ (Note 3)

Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = 10\text{ V}, V_{DD} = 48\text{ V},$ $I_D = 60\text{ A}, R_G = 2.5\ \Omega$		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}	$V_{GS} = 0\text{ V}$ $I_S = 60\text{ A}$	$T_J = 25^\circ\text{C}$		1.0	1.2	V_{dc}
			$T_J = 125^\circ\text{C}$		0.9		
Reverse Recovery Time	t_{rr}	$I_S = 60\text{ A}_{dc}, V_{GS} = 0\text{ V}_{dc},$ $di_S/dt = 100\text{ A}/\mu\text{s}$		75		ns	
Charge Time	t_a			54			
Discharge Time	t_b			21			
Reverse Recovery Stored Charge	Q_{RR}			96			nC

- Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle $\leq 2\%$.
- Switching characteristics are independent of operating junction temperatures.

TYPICAL PERFORMANCE CURVES

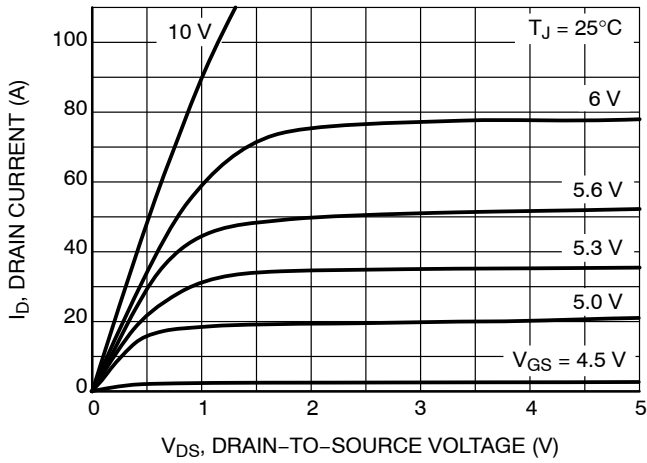


Figure 1. On-Region Characteristics

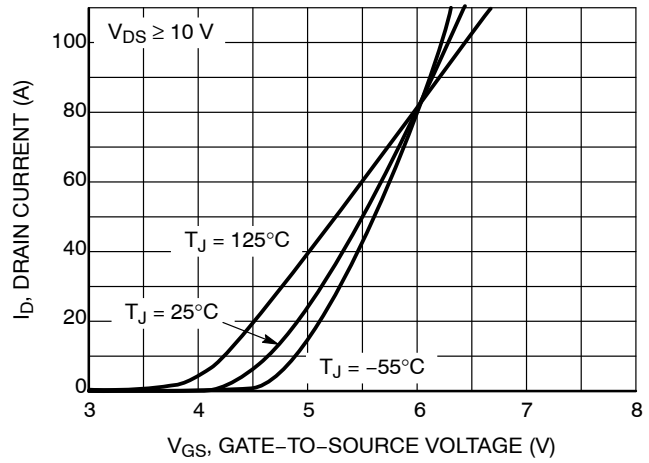


Figure 2. Transfer Characteristics

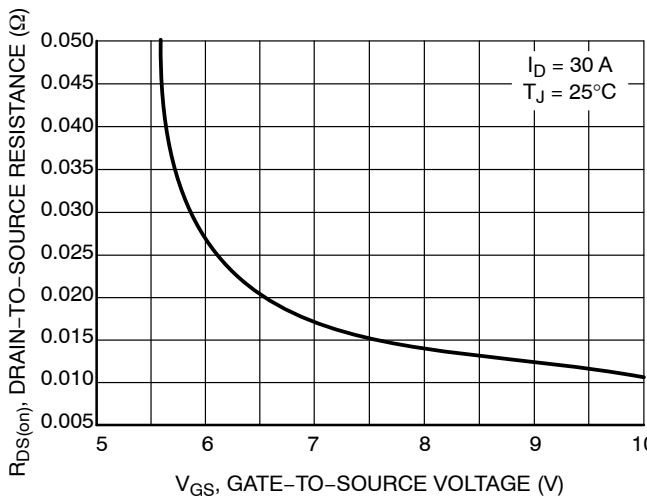


Figure 3. On-Resistance vs. Gate-to-Source Voltage

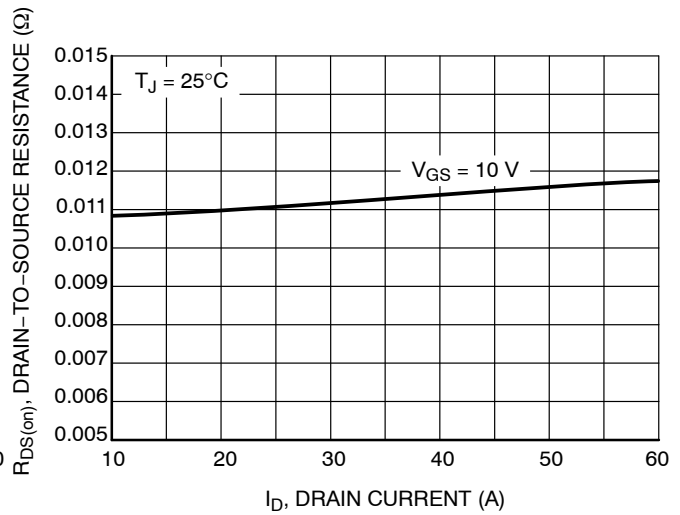


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

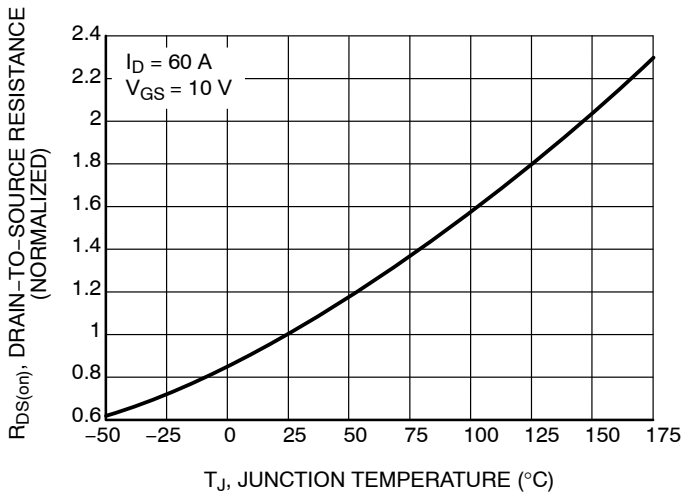


Figure 5. On-Resistance Variation with Temperature

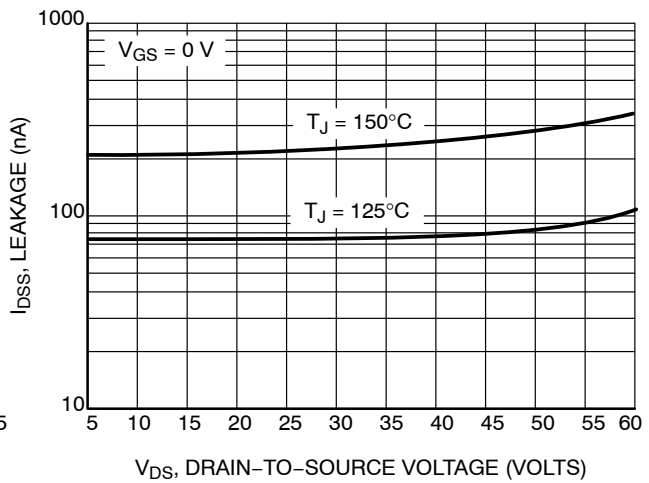


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL PERFORMANCE CURVES

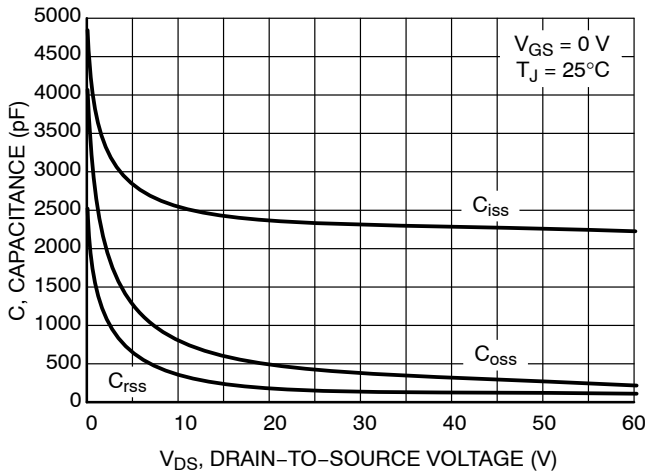


Figure 7. Capacitance Variation

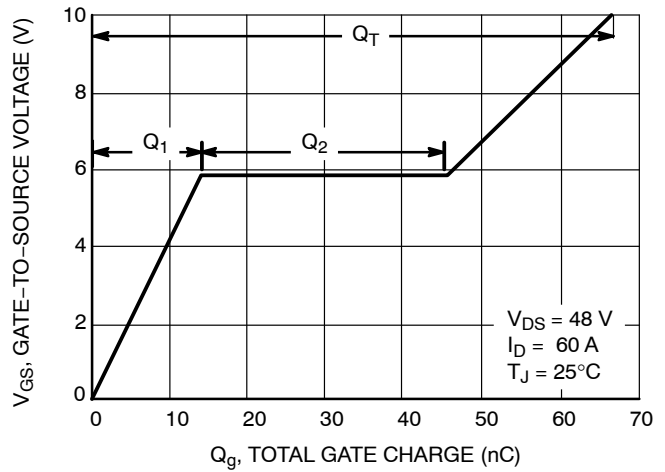


Figure 8. Gate-to-Source Voltage vs. Total Charge

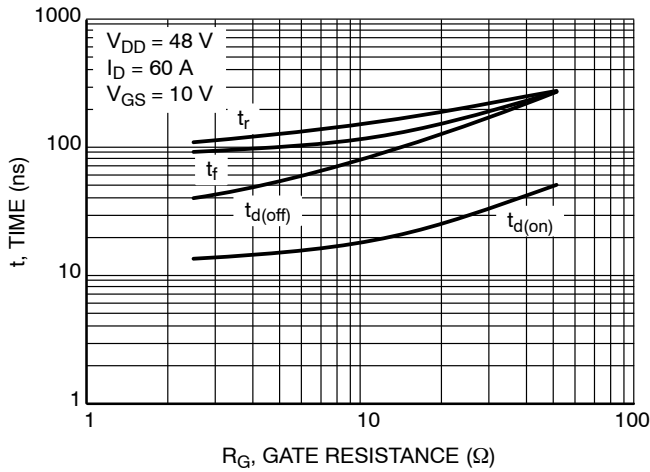


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

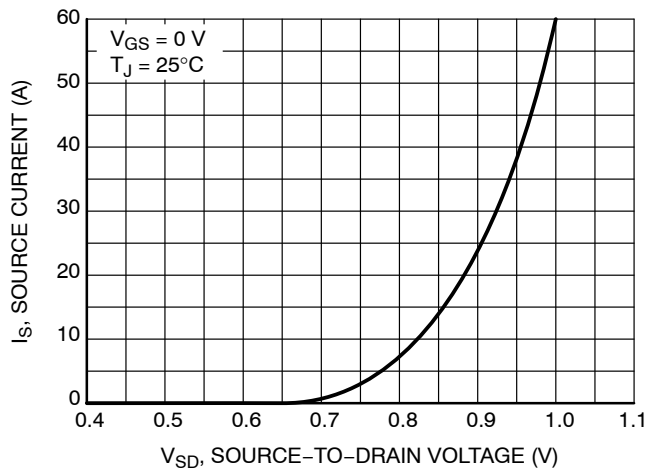


Figure 10. Diode Forward Voltage vs. Current

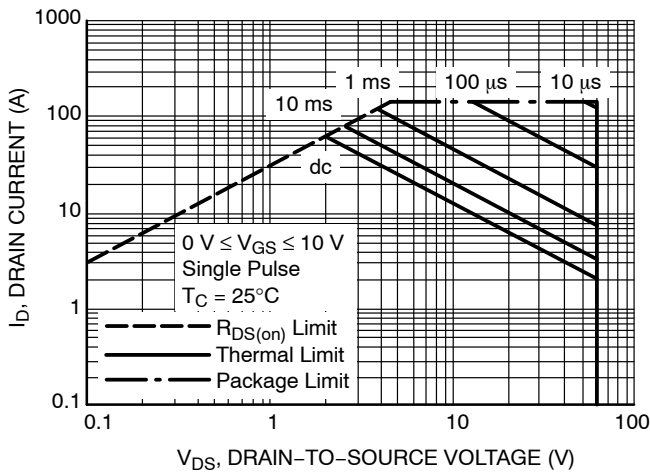


Figure 11. Maximum Rated Forward Biased Safe Operating Area

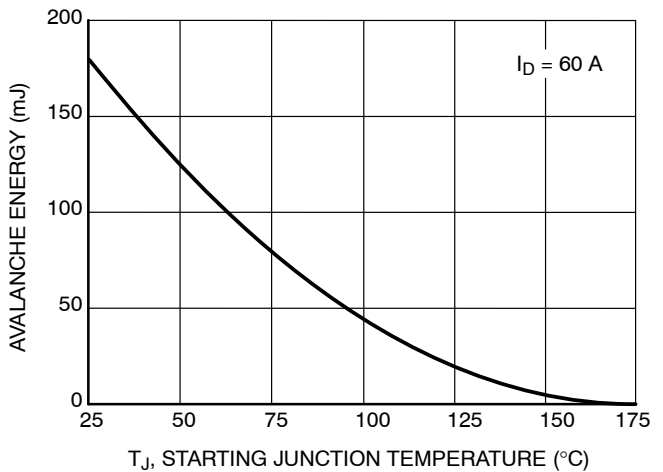


Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature

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TYPICAL PERFORMANCE CURVES

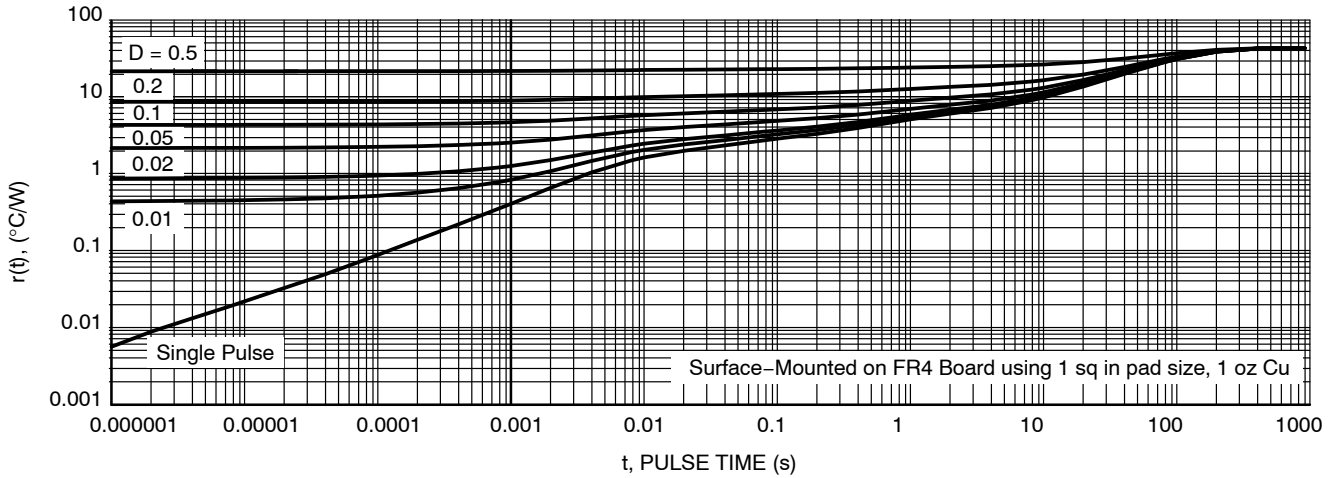


Figure 13. Thermal Response

ORDERING INFORMATION

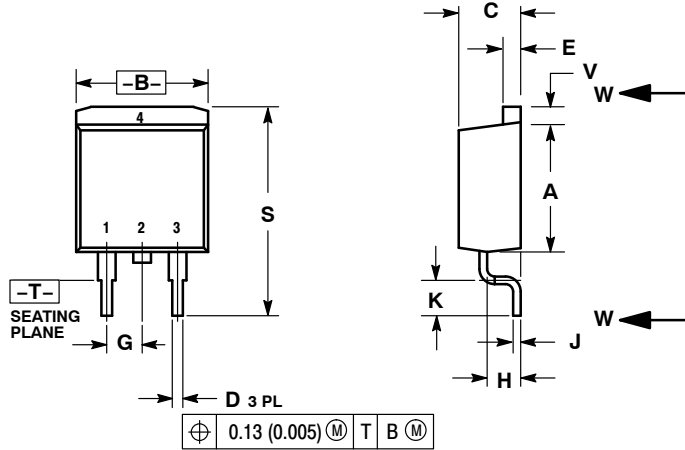
Device	Package	Shipping [†]
NTP5412NG	TO-220AB (Pb-Free)	50 Units / Rail
NTB5412NT4G	D ² PAK (Pb-Free)	800 / Tape & Reel

[†]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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PACKAGE DIMENSIONS

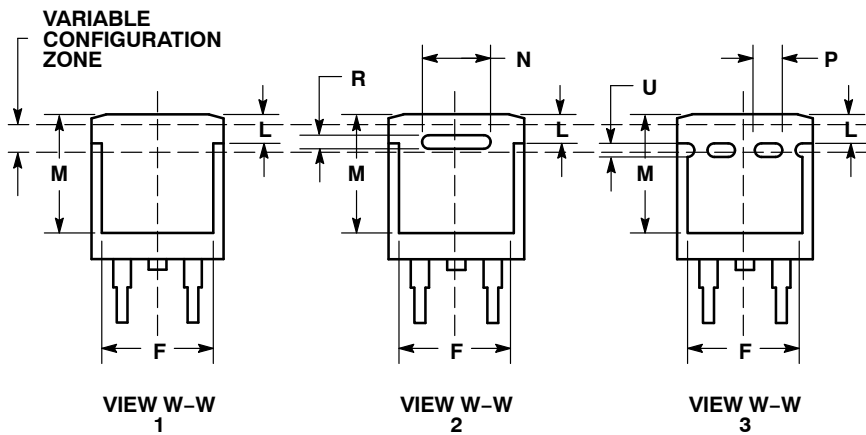
D²PAK 3
CASE 418B-04
ISSUE K



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.

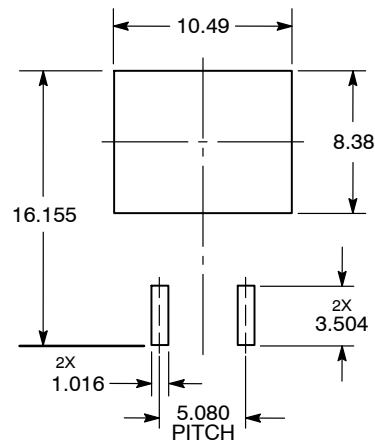
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.340	0.380	8.64	9.65
B	0.380	0.405	9.65	10.29
C	0.160	0.190	4.06	4.83
D	0.020	0.035	0.51	0.89
E	0.045	0.055	1.14	1.40
F	0.310	0.350	7.87	8.89
G	0.100 BSC		2.54 BSC	
H	0.080	0.110	2.03	2.79
J	0.018	0.025	0.46	0.64
K	0.090	0.110	2.29	2.79
L	0.052	0.072	1.32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

SOLDERING FOOTPRINT*



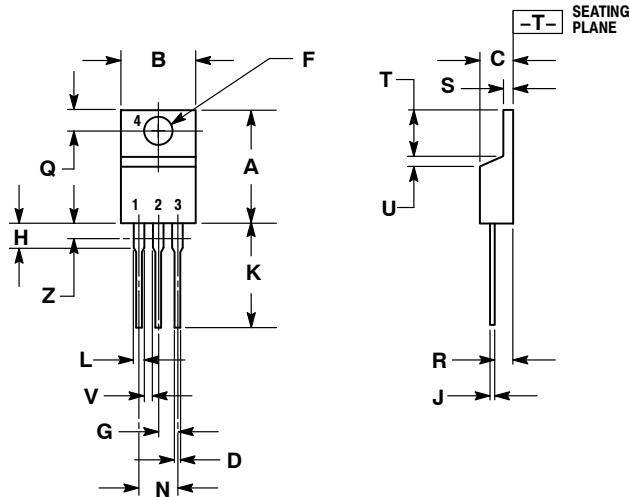
DIMENSIONS: MILLIMETERS

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

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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:

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

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