

MOSFET – Power, N-Channel

100 V, 42 A, 28 mΩ

NTB6413AN, NTP6413AN, NVB6413AN

Features

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

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

Symbol	Parameter		Value	Unit
V_{DSS}	Drain-to-Source Voltage		100	V
V_{GS}	Gate-to-Source Voltage – Continuous		± 20	V
I_D	Continuous Drain Current $R_{\theta JC}$	Steady State	$T_C = 25^\circ\text{C}$ 42	A
			$T_C = 100^\circ\text{C}$ 28	
P_D	Power Dissipation $R_{\theta JC}$	Steady State	$T_C = 25^\circ\text{C}$ 136	W
I_{DM}	Pulsed Drain Current	$t_p = 10 \mu\text{s}$	178	A
T_J, T_{stg}	Operating Junction and Storage Temperature Range		-55 to +175	$^\circ\text{C}$
I_S	Source Current (Body Diode)		42	A
E_{AS}	Single Pulse Drain-to-Source Avalanche Energy ($V_{DD} = 50 \text{ Vdc}$, $V_{GS} = 10 \text{ Vdc}$, $I_{L(pk)} = 36.5 \text{ A}$, $L = 0.3 \text{ mH}$, $R_G = 25 \Omega$)		200	mJ
T_L	Lead Temperature for Soldering Purposes, 1/8" from Case for 10 Seconds		260	$^\circ\text{C}$

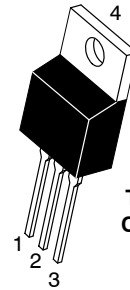
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

THERMAL RESISTANCE RATINGS

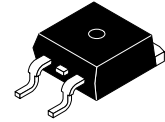
Symbol	Parameter	Max	Unit
$R_{\theta JC}$	Junction-to-Case (Drain) Steady State	1.1	$^\circ\text{C/W}$
$R_{\theta JA}$	Junction-to-Ambient (Note 1)	35	

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

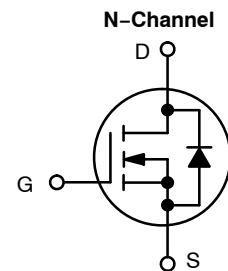
$V_{(BR)DSS}$	$R_{DS(ON) MAX}$	$I_D MAX$ (Note 1)
100 V	28 mΩ @ 10 V	42 A



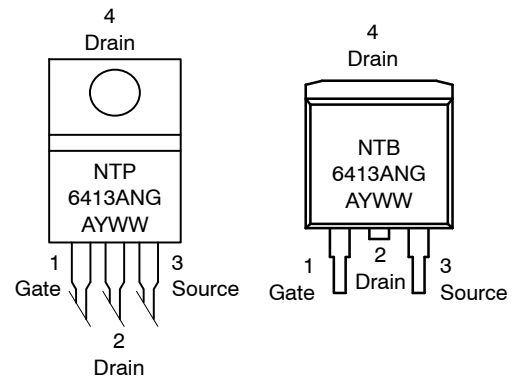
TO-220AB
CASE 221A
STYLE 5



D2PAK
CASE 418AJ
STYLE 2



MARKING DIAGRAM & PIN ASSIGNMENT



6413AN = Specific Device Code
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.

NOTE: Some of the devices on this data sheet have been **DISCONTINUED**. Please refer to the table on page 5.

NTB6413AN, NTP6413AN, NVB6413AN

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

Symbol	Characteristics	Test Condition	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

V _{(BR)DSS}	Drain-to-Source Breakdown Voltage	V _{GS} = 0 V, I _D = 250 μA	100			V
V _{(BR)DSS} /T _J	Drain-to-Source Breakdown Voltage Temperature Coefficient			115		mV/°C
I _{DSS}	Zero Gate Voltage Drain Current	V _{GS} = 0 V, V _{DS} = 100 V	T _J = 25°C		1.0	μA
			T _J = 125°C		100	
I _{GSS}	Gate-to-Source Leakage Current	V _{DS} = 0 V, V _{GS} = ±20 V			±100	nA

ON CHARACTERISTICS (Note 4)

V _{GS(th)}	Gate Threshold Voltage	V _{GS} = V _{DS} , I _D = 250 μA	2.0		4.0	V
V _{GS(th)} /T _J	Negative Threshold Temperature Coefficient			8.1		mV/°C
R _{DS(on)}	Drain-to-Source On-Resistance	V _{GS} = 10 V, I _D = 42 A		25.6	28	mΩ
g _{FS}	Forward Transconductance	V _{GS} = 5 V, I _D = 20 A		17.9		S

CHARGES, CAPACITANCES & GATE RESISTANCE

C _{iss}	Input Capacitance	V _{DS} = 25 V, V _{GS} = 0 V, f = 1 MHz		1800		pF	
C _{oss}	Output Capacitance			280			
C _{rss}	Reverse Transfer Capacitance			100			
Q _{G(TOT)}	Total Gate Charge	V _{GS} = 10 V, V _{DS} = 80 V, I _D = 42 A		51		nC	
Q _{G(TH)}	Threshold Gate Charge			2.0			
Q _{GS}	Gate-to-Source Charge			10			
Q _{GD}	Gate-to-Drain Charge			26			
V _{GP}	Plateau Voltage			5.8			V
R _G	Gate Resistance			2.4			Ω

SWITCHING CHARACTERISTICS, V_{GS} = 10 V (Note 5)

t _{d(on)}	Turn-On Delay Time	V _{GS} = 10 V, V _{DD} = 80 V, I _D = 42 A, R _G = 6.2 Ω		13		ns
t _r	Rise Time			84		
t _{d(off)}	Turn-Off Delay Time			52		
t _f	Fall Time			71		

DRAIN-SOURCE DIODE CHARACTERISTICS

V _{SD}	Forward Diode Voltage	I _S = 42 A	T _J = 25°C	0.92	1.3	V
			T _J = 125°C	0.83		
t _{rr}	Reverse Recovery Time	V _{GS} = 0 V, I _S = 42 A, dI _{SD} /dt = 100 A/μs		73		ns
t _a	Charge Time			56		
t _b	Discharge Time			17		
Q _{RR}	Reverse Recovery Charge			230		

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

TYPICAL CHARACTERISTICS

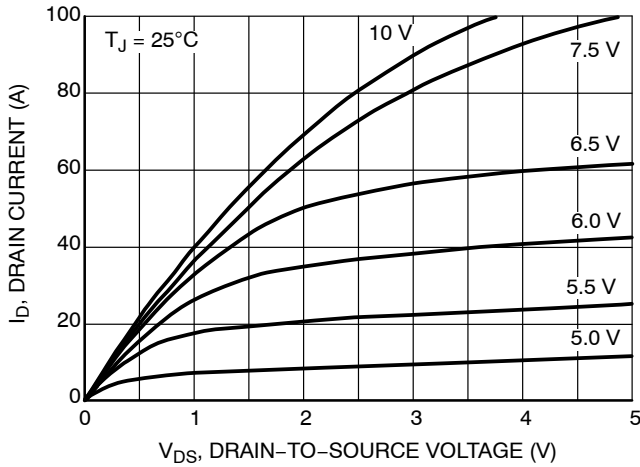


Figure 1. On-Region Characteristics

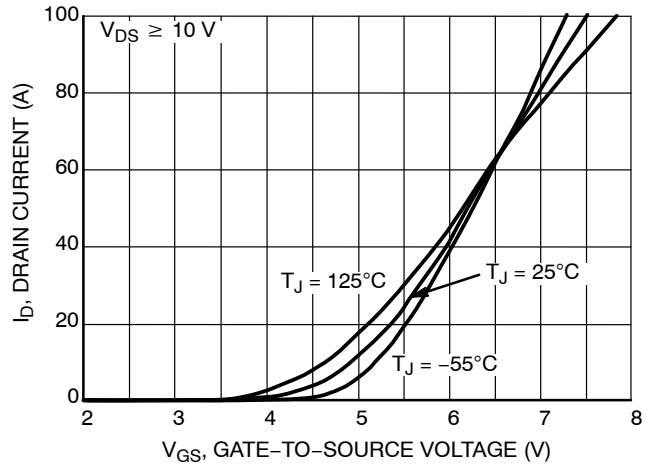


Figure 2. Transfer Characteristics

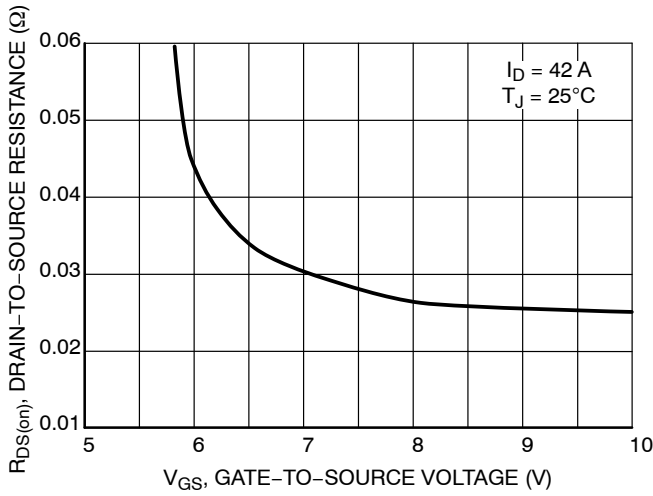


Figure 3. On-Region versus Gate Voltage

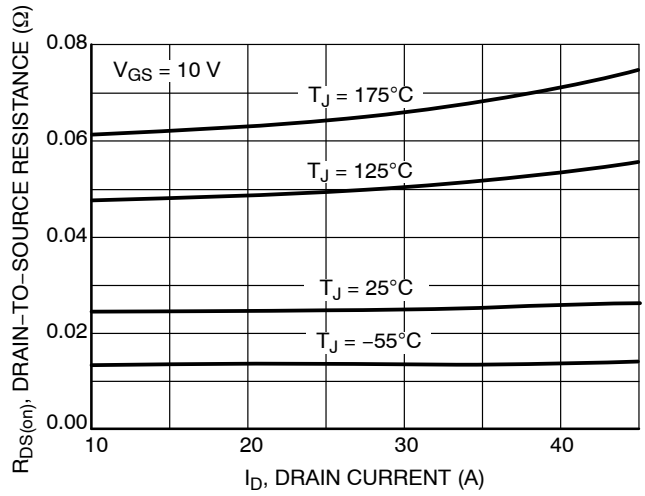


Figure 4. On-Resistance versus Drain Current and Gate Voltage

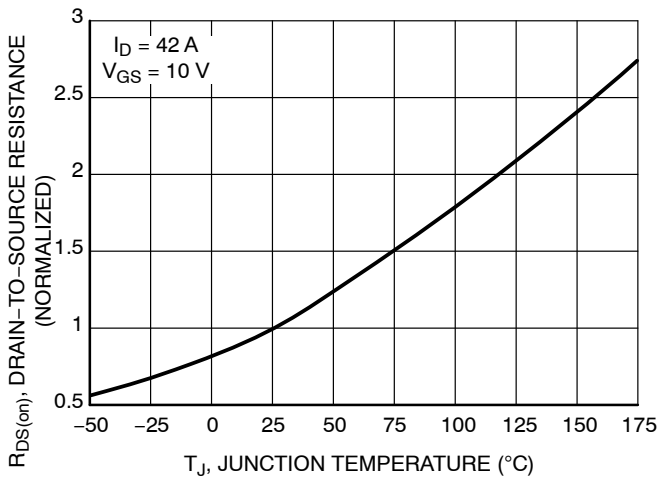


Figure 5. On-Resistance Variation with Temperature

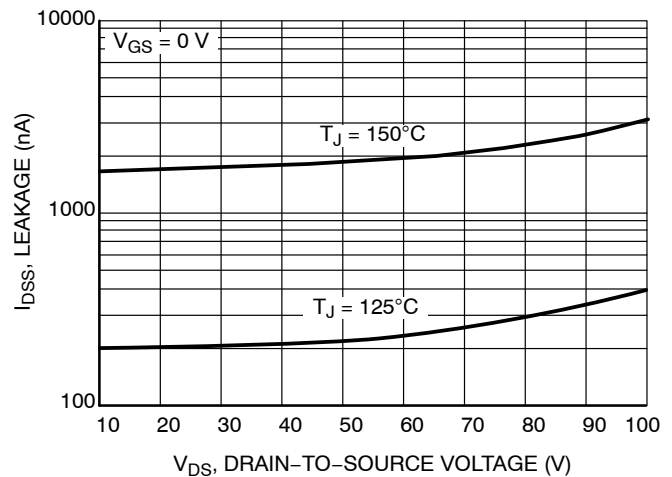


Figure 6. Drain-to-Source Leakage Current versus Voltage

NTB6413AN, NTP6413AN, NVB6413AN

TYPICAL CHARACTERISTICS (continued)

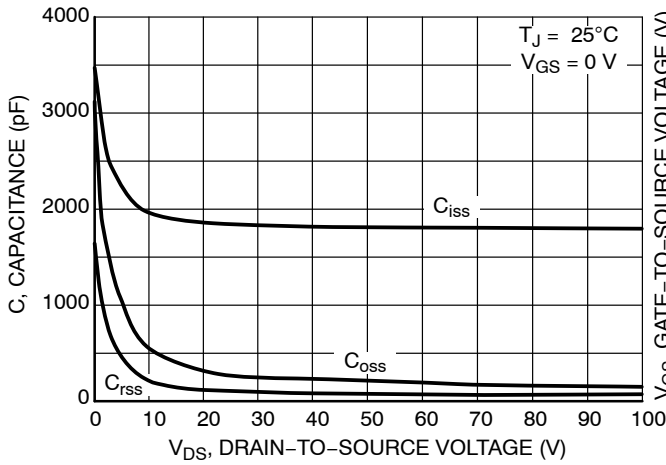


Figure 7. Capacitance Variation

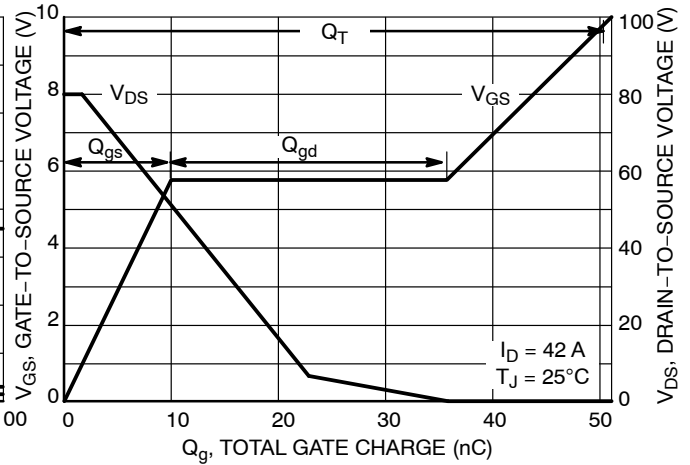


Figure 8. Gate-to-Source Voltage and Drain-to-Source Voltage versus Total Charge

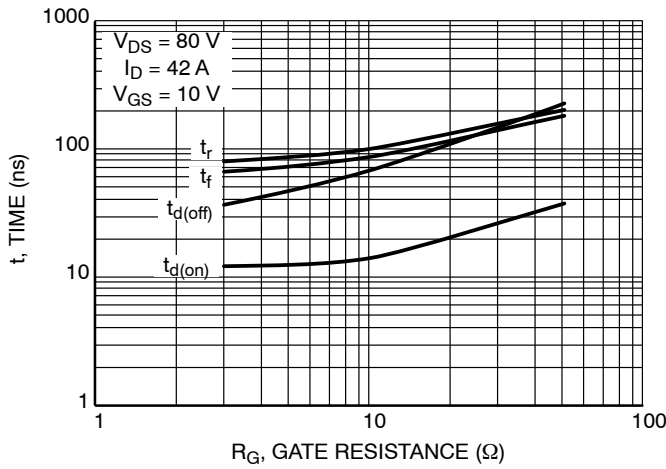


Figure 9. Resistive Switching Time Variation versus Gate Resistance

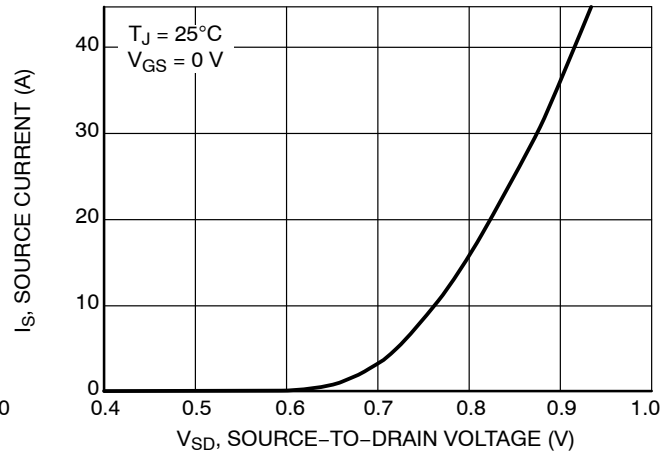


Figure 10. Diode Forward Voltage versus Current

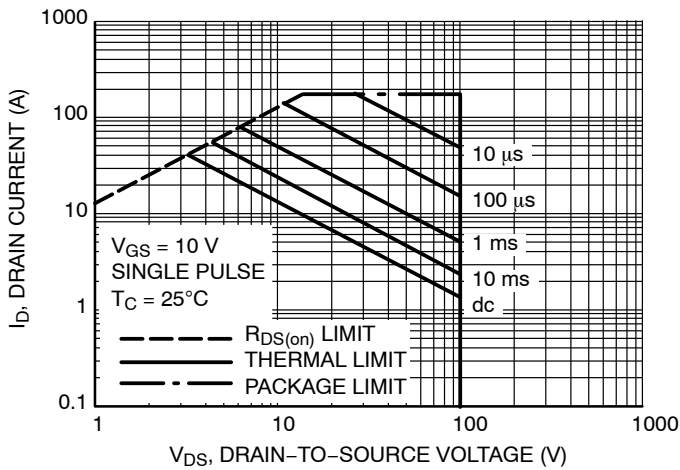


Figure 11. Maximum Rated Forward Biased Safe Operating Area

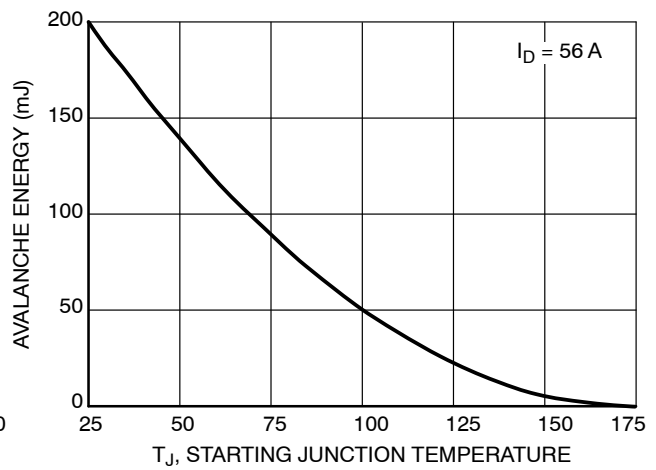


Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature

NTB6413AN, NTP6413AN, NVB6413AN

TYPICAL CHARACTERISTICS (continued)

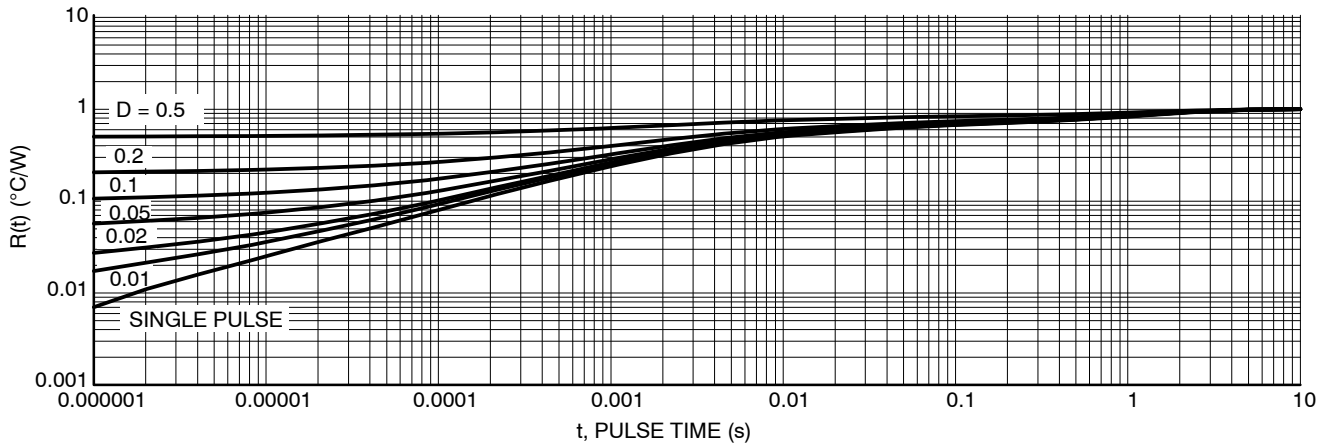


Figure 13. Thermal Response

ORDERING INFORMATION

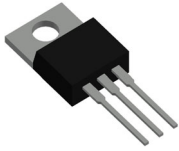
Device	Package	Shipping [†]
NTB6413ANT4G	D ² PAK (Pb-Free)	800 / Tape & Reel

DISCONTINUED (Note 6)

NTB6413ANG	D ² PAK (Pb-Free)	50 Units / Rail
NTP6413ANG	TO-220 (Pb-Free)	50 Units / Rail
NVB6413ANT4G	D ² PAK (Pb-Free)	800 / Tape & Reel

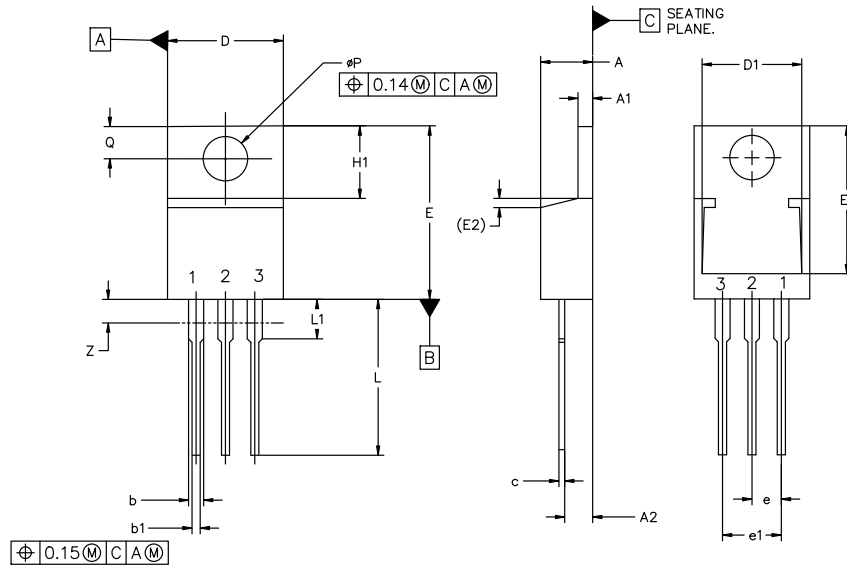
[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](#).

6. **DISCONTINUED:** These devices are not recommended for new design. Please contact your **onsemi** representative for information. The most current information on these devices may be available on www.onsemi.com.



TO-220-3 10.10x15.12x4.45, 2.54P
CASE 221A
ISSUE AL

DATE 05 FEB 2025



MILLIMETERS			
DIM	MIN	NOM	MAX
A	4.07	4.45	4.83
A1	1.15	1.28	1.41
A2	2.04	2.42	2.79
b	1.15	1.34	1.52
b1	0.64	0.80	0.96
c	0.36	0.49	0.61
D	9.66	10.10	10.53
D1	8.43	8.63	8.83
E	14.48	15.12	15.75
E1	12.58	12.78	12.98
E2	1.27 REF		

MILLIMETERS			
DIM	MIN	NOM	MAX
e	2.42	2.54	2.66
e1	4.83	5.08	5.33
H1	5.97	6.22	6.47
L	12.70	13.49	14.27
L1	2.80	3.45	4.10
Q	2.54	2.79	3.04
φP	3.60	3.85	4.09
Z	---	---	3.48

- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
 2. CONTROLLING DIMENSION: MILLIMETERS.
 3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

- | | | | |
|--|--|---|--|
| <p>STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR</p> | <p>STYLE 2:
PIN 1. BASE
2. EMITTER
3. COLLECTOR
4. EMITTER</p> | <p>STYLE 3:
PIN 1. CATHODE
2. ANODE
3. GATE
4. ANODE</p> | <p>STYLE 4:
PIN 1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. MAIN TERMINAL 2</p> |
| <p>STYLE 5:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN</p> | <p>STYLE 6:
PIN 1. ANODE
2. CATHODE
3. ANODE
4. CATHODE</p> | <p>STYLE 7:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. ANODE</p> | <p>STYLE 8:
PIN 1. CATHODE
2. ANODE
3. EXTERNAL TRIP/DELAY
4. ANODE</p> |
| <p>STYLE 9:
PIN 1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR</p> | <p>STYLE 10:
PIN 1. GATE
2. SOURCE
3. DRAIN
4. SOURCE</p> | <p>STYLE 11:
PIN 1. DRAIN
2. SOURCE
3. GATE
4. SOURCE</p> | <p>STYLE 12:
PIN 1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. NOT CONNECTED</p> |

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