

NDF10N60Z, NDP10N60Z

N-Channel Power MOSFET 0.65 Ω , 600 Volts

Features

- Low ON Resistance
- Low Gate Charge
- Zener Diode-protected Gate
- 100% Avalanche Tested
- ROHS Compliant
- This is a Pb-Free Device

Applications

- Adapter (Notebook, Printer, Gaming)
- LCD Panel Power
- ATX Power Supplies
- Lighting Ballasts

ABSOLUTE MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	NDF10N60Z	NDP10N60Z	Unit
Drain-to-Source Voltage	V_{DSS}	600 (Note 1)		V
Continuous Drain Current	I_D	10 (Note 2)		A
Continuous Drain Current $T_A = 100^\circ\text{C}$	I_D	5.7 (Note 2)		A
Pulsed Drain Current, $V_{GS} @ 10\text{ V}$	I_{DM}	36 (Note 2)		A
Power Dissipation (Note 1)	P_D	36	125	W
Gate-to-Source Voltage	V_{GS}	± 30		V
Single Pulse Avalanche Energy, $L = 6.0\text{ mH}$, $I_D = 10\text{ A}$	E_{AS}	300		mJ
ESD (HBM) (JESD 22-114-B)	V_{esd}	3900		V
RMS Isolation Voltage ($t = 0.3\text{ sec.}$, R.H. $\leq 30\%$, $T_A = 25^\circ\text{C}$) (Figure 13)	V_{ISO}	4500		V
Peak Diode Recovery	dv/dt	4.5 (Note 3)		V/ns
Continuous Source Current (Body Diode)	I_S	10		A
Maximum Temperature for Soldering Leads, 0.063" (1.6 mm) from Case for 10 s Package Body for 10 s	T_L T_{PKG}	300 260		$^\circ\text{C}$
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-55 to 150		$^\circ\text{C}$

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.

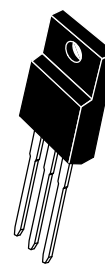
1. Surface mounted on FR4 board using 1" sq. pad size, 1 oz cu
2. Limited by maximum junction temperature
3. $I_S \leq 10\text{ A}$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DD} = 80\% BV_{DSS}$



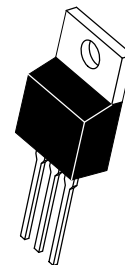
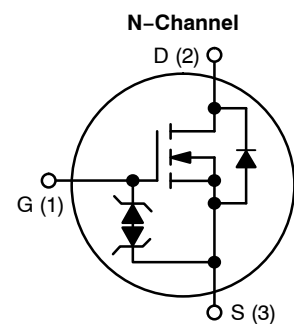
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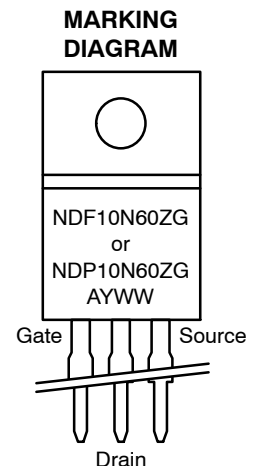
V_{DSS}	$R_{DS(ON)}$ (TYP) @ 5 A
600 V	0.65 Ω



TO-220FP
CASE 221D
STYLE 1



TO-220AB
CASE 221A
STYLE 5



A = Location Code
Y = Year
WW = Work Week
G = Pb-Free Package

ORDERING INFORMATION

Device	Package	Shipping
NDF10N60ZG	TO-220FP	50 Units/Rail
NDP10N60ZG	TO-220AB	In Development

THERMAL RESISTANCE

Parameter	Symbol	NDF10N60Z	NDP10N60Z	Unit
Junction-to-Case (Drain)	$R_{\theta JC}$	3.4	1.0	°C/W
Junction-to-Ambient Steady State (Note 4)	$R_{\theta JA}$	50	50	

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

Characteristic	Test Conditions	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	BV_{DSS}	600			V
Breakdown Voltage Temperature Coefficient	Reference to 25°C , $I_D = 1\text{ mA}$	$\Delta BV_{DSS}/\Delta T_J$		0.6		V/°C
Drain-to-Source Leakage Current	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$	I_{DSS}			1	μA
					50	
Gate-to-Source Forward Leakage	$V_{GS} = \pm 20\text{ V}$	I_{GSS}			± 10	μA

ON CHARACTERISTICS (Note 5)

Static Drain-to-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 5.0\text{ A}$	$R_{DS(on)}$		0.65	0.75	Ω
Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	$V_{GS(th)}$	3.0		4.5	V
Forward Transconductance	$V_{DS} = 15\text{ V}, I_D = 10\text{ A}$	g_{FS}		7.9		S

DYNAMIC CHARACTERISTICS

Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	C_{iss}		1425		pF
Output Capacitance		C_{oss}		150		
Reverse Transfer Capacitance		C_{rss}		35		
Total Gate Charge	$V_{DD} = 300\text{ V}, I_D = 10\text{ A},$ $V_{GS} = 10\text{ V}$	Q_g		47		nC
Gate-to-Source Charge		Q_{gs}		9.0		
Gate-to-Drain ("Miller") Charge		Q_{gd}		26		
Gate Resistance		R_g		1.5		Ω

RESISTIVE SWITCHING CHARACTERISTICS

Turn-On Delay Time	$V_{DD} = 300\text{ V}, I_D = 10\text{ A},$ $V_{GS} = 10\text{ V}, R_G = 5\ \Omega$	$t_{d(on)}$		15		ns
Rise Time		t_r		31		
Turn-Off Delay Time		$t_{d(off)}$		40		
Fall Time		t_f		23		

SOURCE-DRAIN DIODE CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Diode Forward Voltage	$I_S = 10\text{ A}, V_{GS} = 0\text{ V}$	V_{SD}			1.6	V
Reverse Recovery Time	$V_{GS} = 0\text{ V}, V_{DD} = 30\text{ V}$ $I_S = 10\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$	t_{rr}		395		ns
Reverse Recovery Charge		Q_{rr}		3.0		μC

4. Insertion mounted

5. Pulse Width $\leq 380\ \mu\text{s}$, Duty Cycle $\leq 2\%$.

TYPICAL CHARACTERISTICS

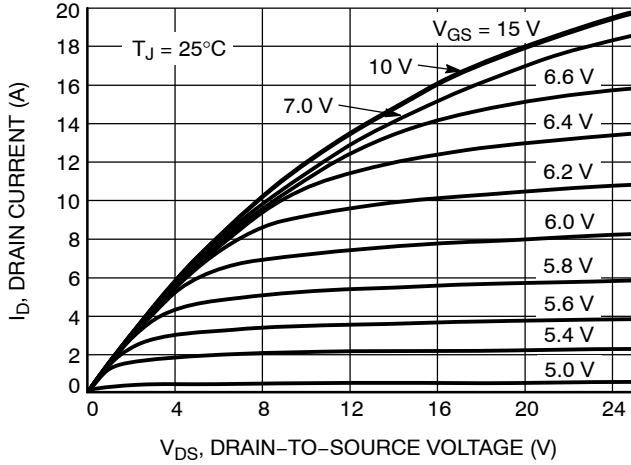


Figure 1. On-Region Characteristics

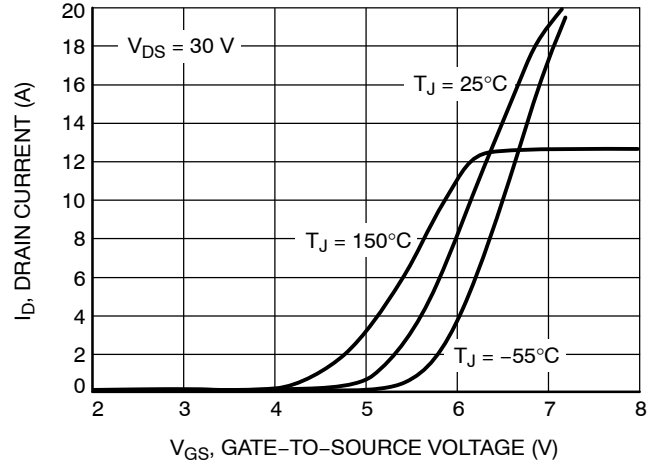


Figure 2. Transfer Characteristics

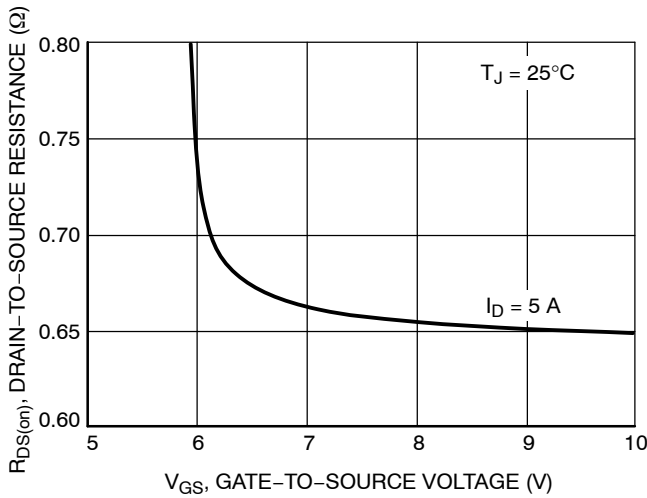


Figure 3. On-Resistance vs. Gate Voltage

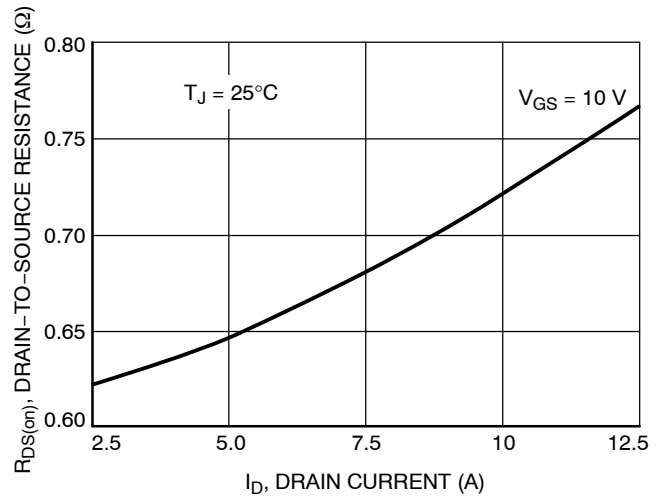


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

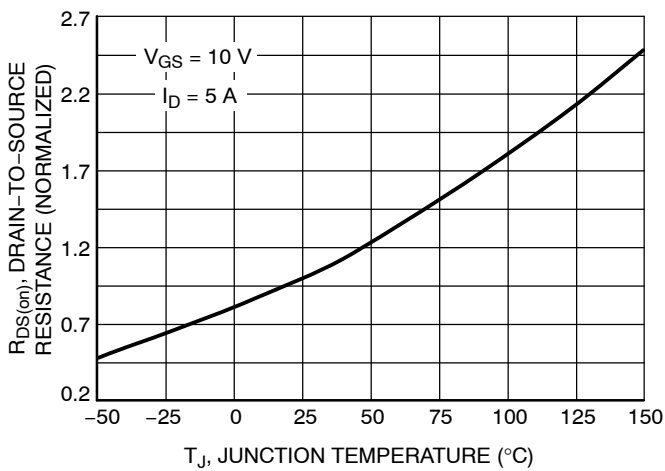


Figure 5. On-Resistance Variation with Temperature

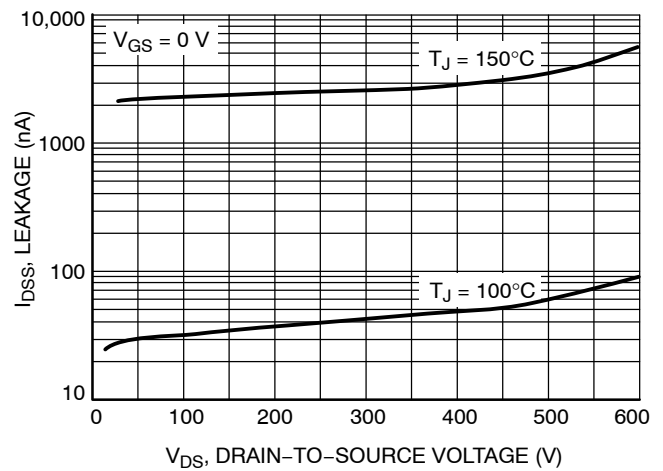


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

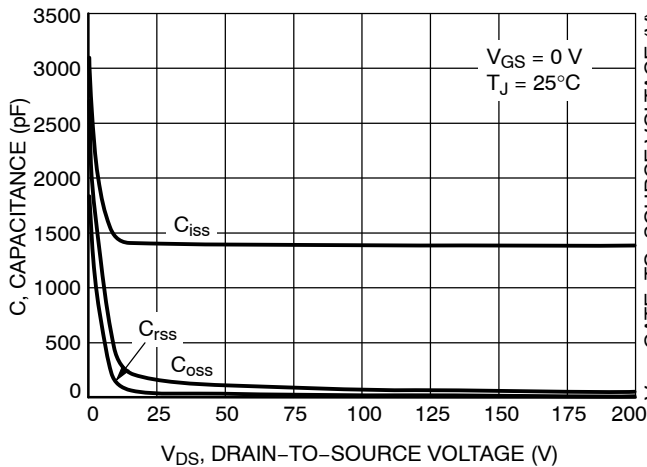


Figure 7. Capacitance Variation

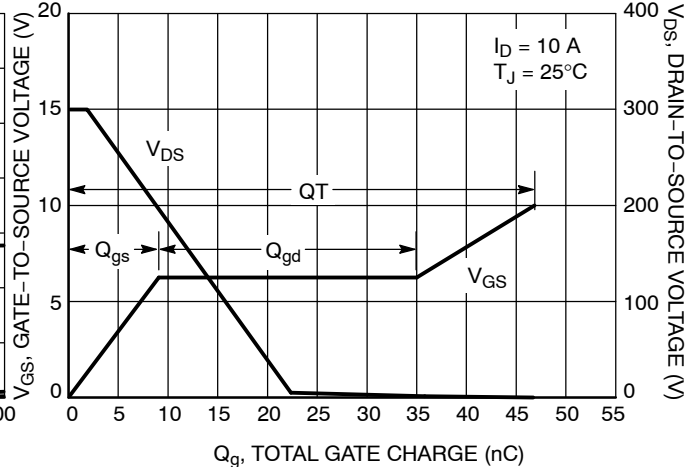


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

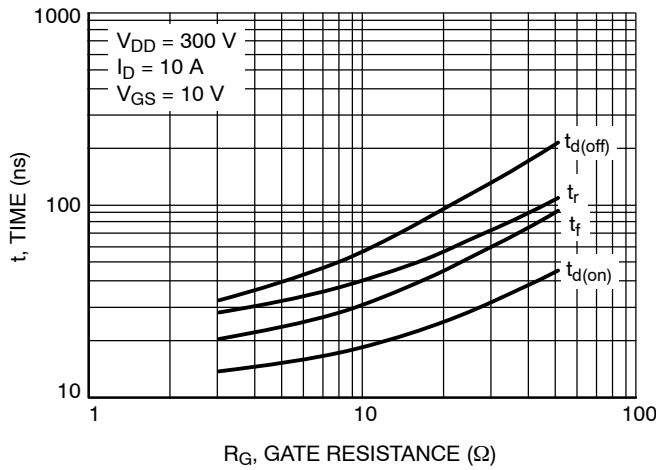


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

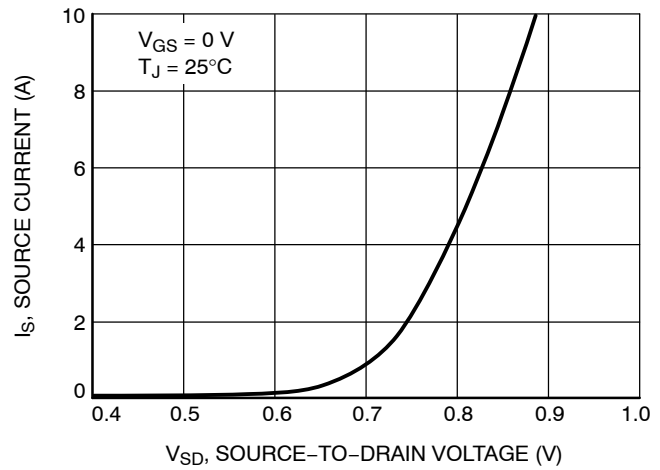


Figure 10. Diode Source Current vs. Forward Voltage

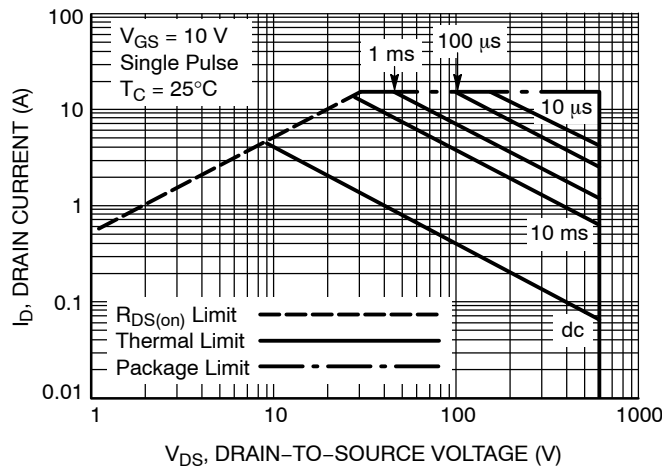


Figure 11. Maximum Rated Forward Biased Safe Operating Area for NDF10N60Z

Mounted on 2" sq. FR4 board (1" sq. 2 oz. Cu 0.06" thick single sided) with one die operating

TYPICAL CHARACTERISTICS

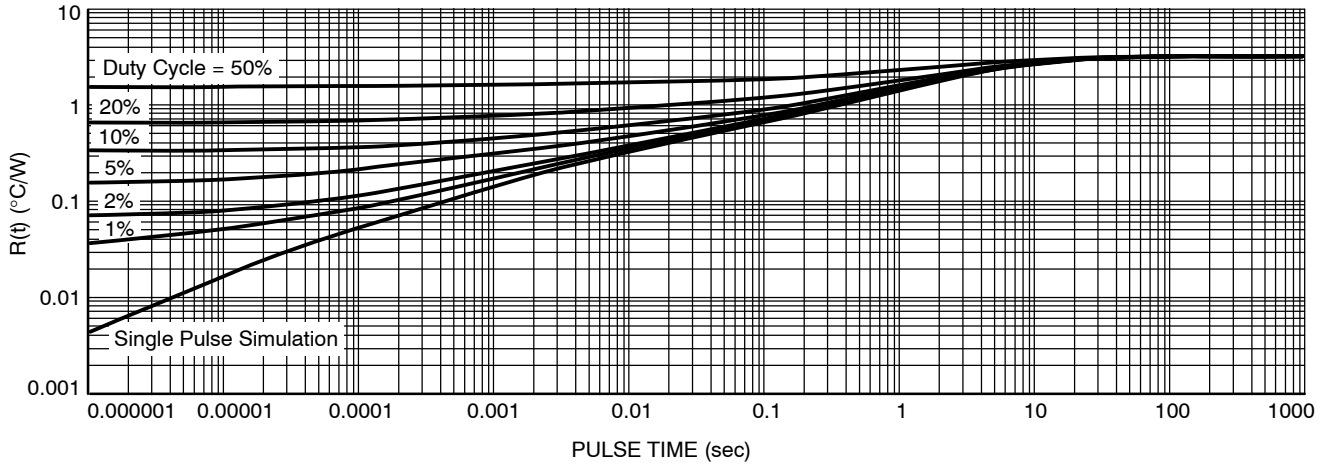


Figure 12. Thermal Impedance for NDF10N60Z

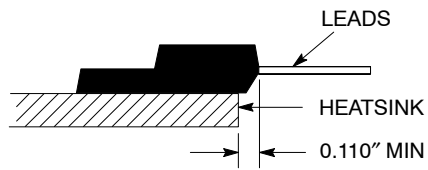
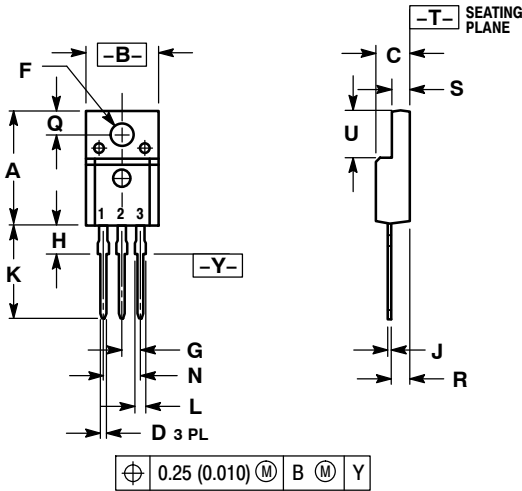


Figure 13. Mounting Position for Isolation Test

Measurement made between leads and heatsink with all leads shorted together.

PACKAGE DIMENSIONS

TO-220FP
CASE 221D-03
ISSUE K

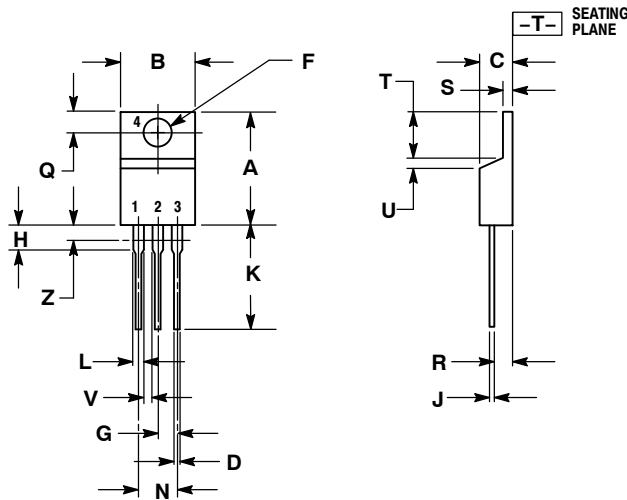


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH
 3. 221D-01 THRU 221D-02 OBSOLETE, NEW STANDARD 221D-03.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.617	0.635	15.67	16.12
B	0.392	0.419	9.96	10.63
C	0.177	0.193	4.50	4.90
D	0.024	0.039	0.60	1.00
F	0.116	0.129	2.95	3.28
G	0.100 BSC		2.54 BSC	
H	0.118	0.135	3.00	3.43
J	0.018	0.025	0.45	0.63
K	0.503	0.541	12.78	13.73
L	0.048	0.058	1.23	1.47
N	0.200 BSC		5.08 BSC	
Q	0.122	0.138	3.10	3.50
R	0.099	0.117	2.51	2.96
S	0.092	0.113	2.34	2.87
U	0.239	0.271	6.06	6.88

- STYLE 1:
PIN 1. GATE
2. DRAIN
3. SOURCE

TO-220AB
CASE 221A-09
ISSUE AE



- 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. SOURCE
3. DRAIN
4. DRAIN

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