

# MOSFET - N-Channel, Shielded Gate PowerTrench 120 V, 2.95 mΩ, 181 A

## FDP2D9N12C

### Features

- Shielded Gate MOSFET Technology
- Max  $R_{DS(on)} = 2.95 \text{ m}\Omega$  at  $V_{GS} = 10 \text{ V}$ ,  $I_D = 181 \text{ A}$
- 50% Lower  $Q_{rr}$  than Other MOSFET Suppliers
- Lowers Switching Noise/EMI
- 100% UIL Tested
- These Devices are Pb-Free, Halogen-Free and are RoHS Compliant

### Typical Applications

- Synchronous Rectification for ATX / Server / Telecom PSU
- Motor Drives and Uninterruptible Power Supplies
- Micro Solar Inverter

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

Parameter			Symbol	Value	Unit
Drain-to-Source Voltage			V <sub>DSS</sub>	120	V
Gate-to-Source Voltage			V <sub>GS</sub>	±20	V
Continuous Drain Current R <sub>θJC</sub> (Note 2)	Steady State	T <sub>C</sub> = 25°C	I <sub>D</sub>	181	A
Power Dissipation R <sub>θJC</sub> (Note 2)			P <sub>D</sub>	179	W
Continuous Drain Current R <sub>θJA</sub> (Notes 1, 2)	Steady State	T <sub>A</sub> = 25°C	I <sub>D</sub>	19.5	A
Power Dissipation R <sub>θJA</sub> (Notes 1, 2)			P <sub>D</sub>	2.0	W
Pulsed Drain Current	T <sub>A</sub> = 25°C, t <sub>p</sub> = 10 μs		I <sub>DM</sub>	933	A
Operating Junction and Storage Temperature Range			T <sub>J</sub> , T <sub>stg</sub>	-55 to +150	°C
Source Current (Body Diode)			I <sub>S</sub>	172	A
Single Pulse Drain-to-Source Avalanche Energy (I <sub>AV</sub> = 99 A <sub>pk</sub> , L = 0.1 mH)			E <sub>AS</sub>	490	mJ
Lead Temperature Soldering Reflow for Soldering Purposes (1/8" from case for 10 s)			T <sub>L</sub>	300	°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.

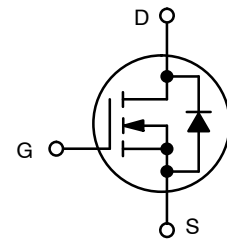
1. Surface-mounted on FR4 board using a 1 in<sup>2</sup> pad size, 1 oz. Cu pad.
2. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.



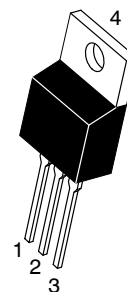
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$V_{(BR)DSS}$	$R_{DS(ON)} \text{ MAX}$	$I_D \text{ MAX}$
120 V	2.95 mΩ @ 10 V	181 A

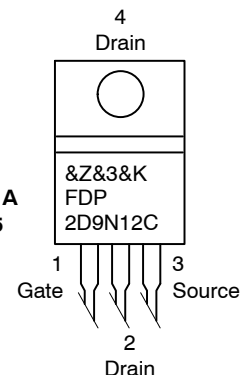


N-CHANNEL MOSFET



TO-220  
CASE 221A  
STYLE 5

### MARKING DIAGRAM



&Z = Assembly Plant Code  
&3 = Date Code (Year & Week)  
&K = Lot

### ORDERING INFORMATION

Device	Package	Shipping†
FDP2D9N12C	TO-220 (Pb-Free)	50 / Tube, 800 / Box

†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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## THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Case – Steady State (Note 2)	$R_{\theta JC}$	0.7	°C/W
Junction-to-Ambient – Steady State (Note 2)	$R_{\theta JA}$	62.5	

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	120			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 250\text{ }\mu\text{A}$ , ref to $25^\circ\text{C}$		46		mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 96\text{ V}$			1	$\mu\text{A}$
		$T_J = 150^\circ\text{C}$			100	$\mu\text{A}$
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA

### ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 664\text{ }\mu\text{A}$	2.0	3.1	4.0	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$	$I_D = 664\text{ }\mu\text{A}$ , ref to $25^\circ\text{C}$		-8.6		mV/°C
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 95\text{ A}$		2.7	2.95	m $\Omega$
		$V_{GS} = 6\text{ V}, I_D = 57\text{ A}$		3.5	5.1	m $\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS} = 10\text{ V}, I_D = 50\text{ A}$		215		S

### CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 60\text{ V}$		7910	12883	pF
Output Capacitance	$C_{OSS}$			3825		
Reverse Transfer Capacitance	$C_{RSS}$			32		
Gate-Resistance	$R_G$			0.78	1.9	$\Omega$
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 10\text{ V}, V_{DS} = 60\text{ V}; I_D = 95\text{ A}$		98	137	nC
Threshold Gate Charge	$Q_{G(TH)}$			23		
Gate-to-Source Charge	$Q_{GS}$			35		
Gate-to-Drain Charge	$Q_{GD}$			15		
Plateau Voltage	$V_{GP}$			5.0		
Output Charge	$Q_{OSS}$	$V_{DD} = 60\text{ V}, V_{GS} = 0\text{ V}$		325		nC

### SWITCHING CHARACTERISTICS (Note 4)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 10\text{ V}, V_{DD} = 60\text{ V}, I_D = 95\text{ A}, R_G = 6.0\text{ }\Omega$		43		ns
Rise Time	$t_r$			31		
Turn-Off Delay Time	$t_{d(OFF)}$			72		
Fall Time	$t_f$			24		

### DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_S = 95\text{ A}$	$T_J = 25^\circ\text{C}$		0.9	1.3	V
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, V_{DD} = 60\text{ V}$ $di_S/dt = 300\text{ A}/\mu\text{s}, I_S = 100\text{ A}$			88		ns
Charge Time	$t_a$				48		
Discharge Time	$t_b$				40		
Reverse Recovery Charge	$Q_{RR}$				500		nC

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

3. Pulse Test: pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .

4. Switching characteristics are independent of operating junction temperatures.

TYPICAL CHARACTERISTICS

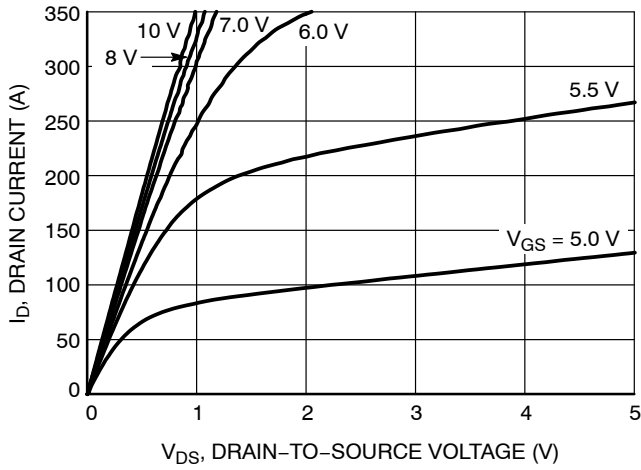


Figure 1. On-Region Characteristics

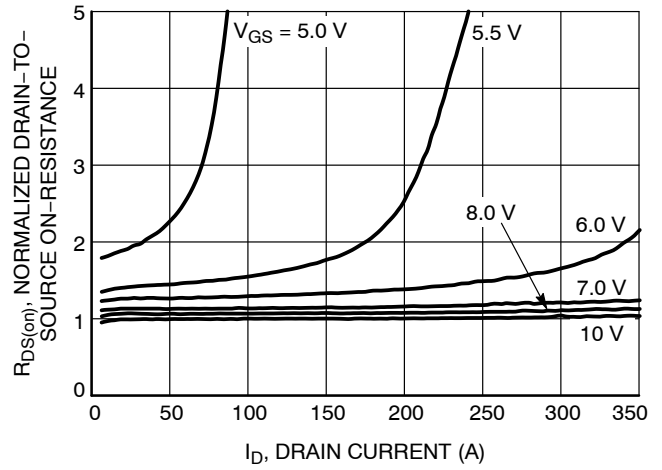


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

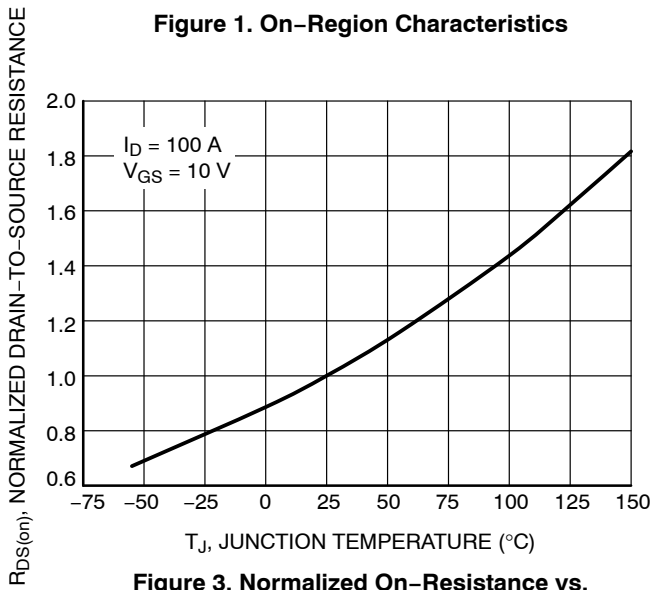


Figure 3. Normalized On-Resistance vs. Junction Temperature

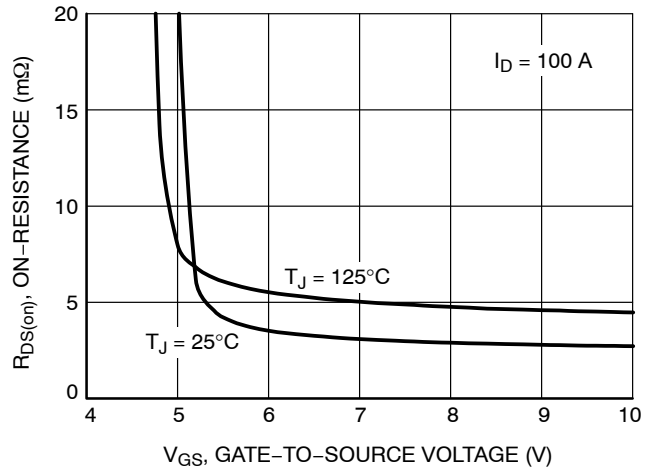


Figure 4. On-Resistance vs. Gate-to-Source Voltage

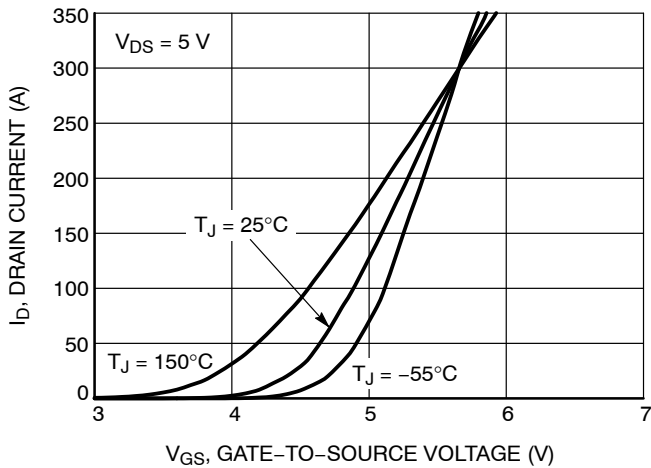


Figure 5. Transfer Characteristics

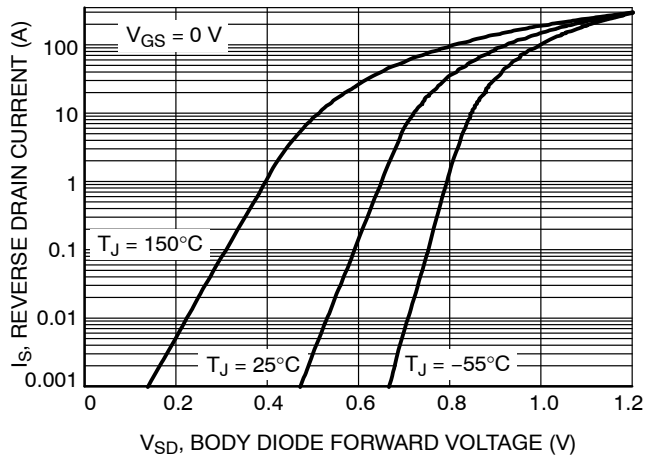


Figure 6. Source-to-Drain Diode Forward Voltage vs. Source Current

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## TYPICAL CHARACTERISTICS

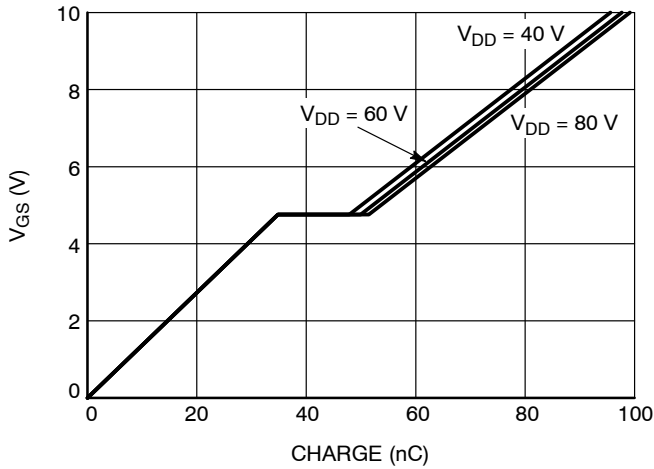


Figure 7. Gate Charge Characteristics

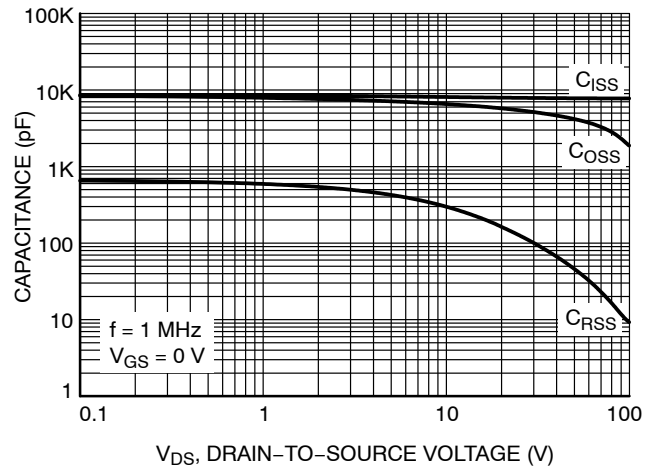


Figure 8. Capacitance vs. Drain-to-Source Voltage

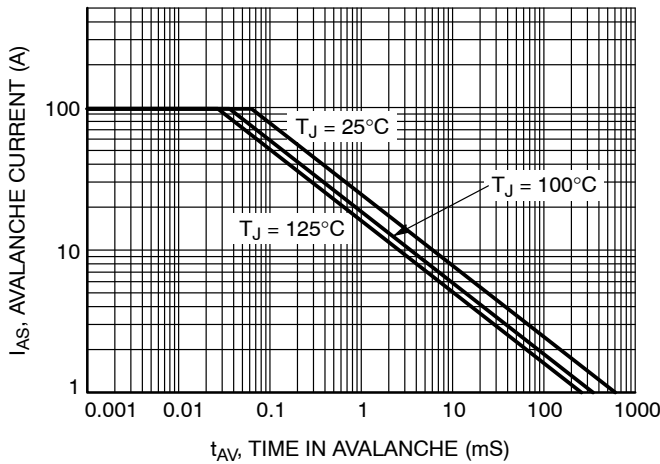


Figure 9. Unclamped Inductive Switching Capability

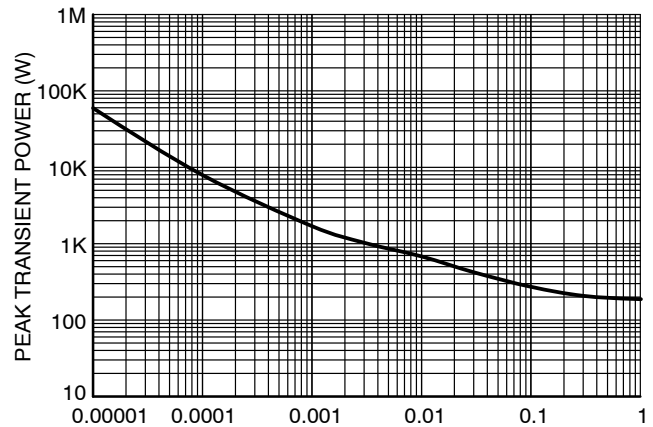


Figure 10. Peak Power

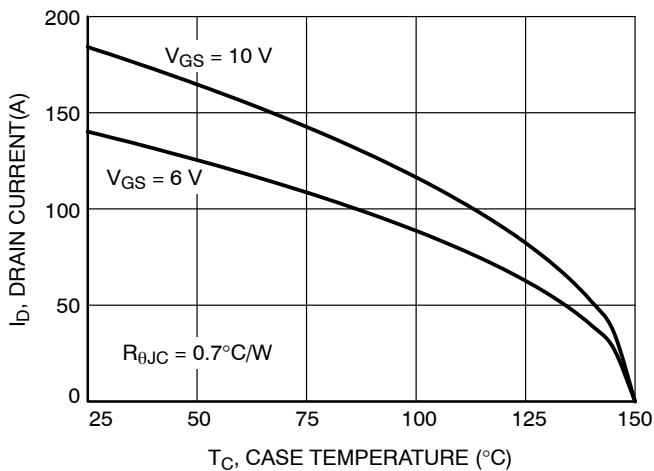


Figure 11. Drain Current vs. Case Temperature

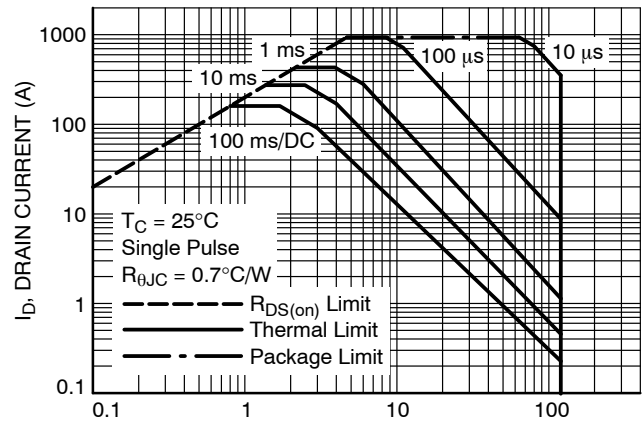


Figure 12. Forward Bias Safe Operating Area

# FDP2D9N12C

## TYPICAL CHARACTERISTICS

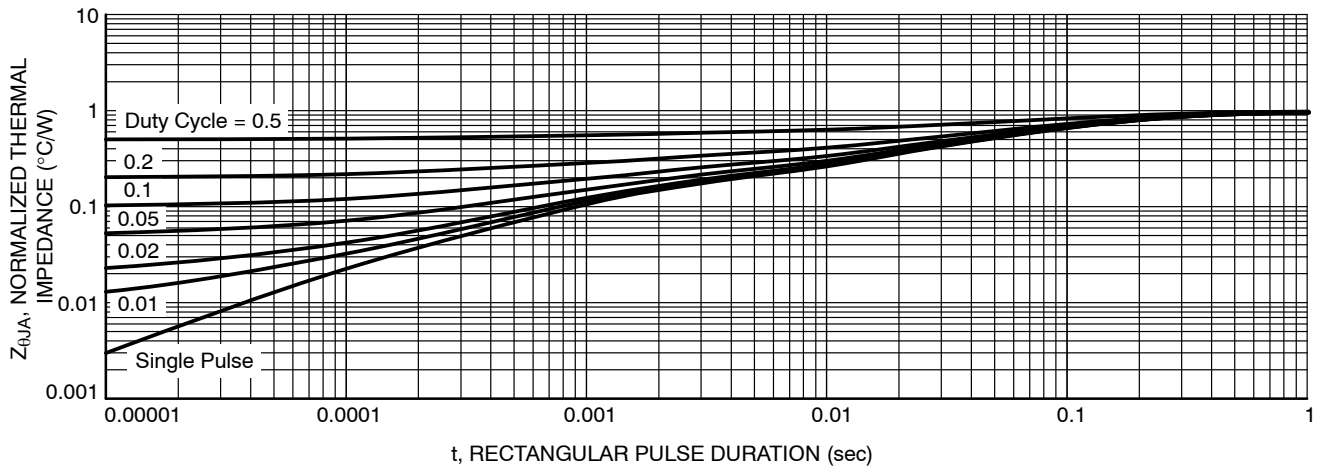
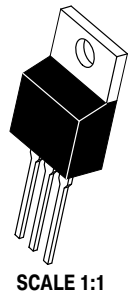


Figure 13. Transient Thermal Impedance

# MECHANICAL CASE OUTLINE

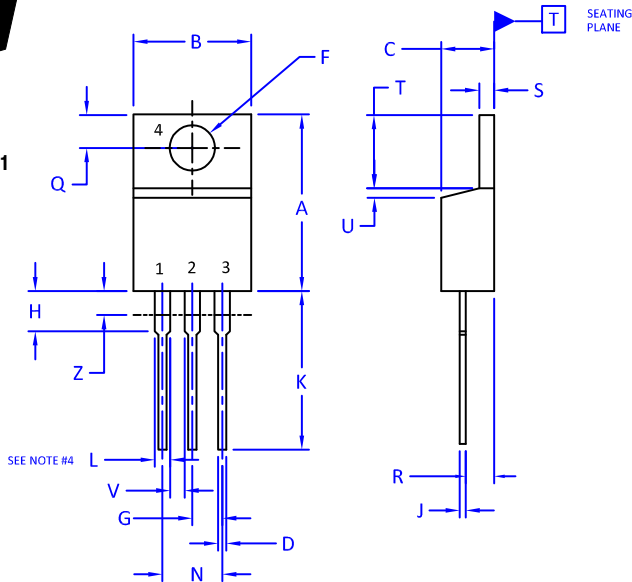
## PACKAGE DIMENSIONS

ON Semiconductor®



### TO-220 CASE 221A-09 ISSUE AJ

DATE 05 NOV 2019



#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 2009.
2. CONTROLLING DIMENSION: INCHES
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.
4. MAX WIDTH FOR F102 DEVICE = 1.35MM

DIM	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.570	0.620	14.48	15.75
B	0.380	0.415	9.66	10.53
C	0.160	0.190	4.07	4.83
D	0.025	0.038	0.64	0.96
F	0.142	0.161	3.60	4.09
G	0.095	0.105	2.42	2.66
H	0.110	0.161	2.80	4.10
J	0.014	0.024	0.36	0.61
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	1.41
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 1:

- PIN 1. BASE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

#### STYLE 2:

- PIN 1. BASE  
2. EMITTER  
3. COLLECTOR  
4. EMITTER

#### STYLE 3:

- PIN 1. CATHODE  
2. ANODE  
3. GATE  
4. ANODE

#### STYLE 4:

- PIN 1. MAIN TERMINAL 1  
2. MAIN TERMINAL 2  
3. GATE  
4. MAIN TERMINAL 2

#### STYLE 5:

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

#### STYLE 6:

- PIN 1. ANODE  
2. CATHODE  
3. ANODE  
4. CATHODE

#### STYLE 7:

- PIN 1. CATHODE  
2. ANODE  
3. CATHODE  
4. ANODE

#### STYLE 8:

- PIN 1. CATHODE  
2. ANODE  
3. EXTERNAL TRIP/DELAY  
4. ANODE

#### STYLE 9:

- PIN 1. GATE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

#### STYLE 10:

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

#### STYLE 11:

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

#### STYLE 12:


- PIN 1. MAIN TERMINAL 1  
2. MAIN TERMINAL 2  
3. GATE  
4. NOT CONNECTED

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DESCRIPTION: TO-220

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