

# MOSFET – N-Channel, Shielded Gate POWERTRENCH®

100 V, 128 A, 4.5 mΩ

## FDP4D5N10C, FDPF4D5N10C

### Description

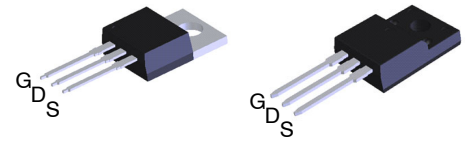
This N-Channel MV MOSFET is produced using onsemi's advanced PowerTrench process that incorporates Shielded Gate technology. This Process has been Optimized to minimize on-state resistance and yet maintain superior switching performance with best in class soft body diode.

### Features

- Max  $R_{DS(on)}$  = 4.5 mΩ at  $V_{GS} = 10\text{ V}$ ,  $I_D = 100\text{ A}$
- Extremely Low Reverse Recovery Charge,  $Q_{rr}$
- 100% UIL Tested
- This Device is Pb-Free Halide, Free and RoHS Compliant.

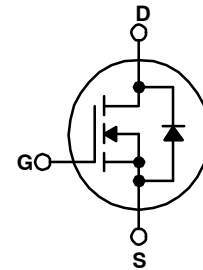
### Applications

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

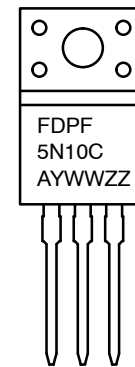


TO-220  
 CASE 221A

TO-220 Fullpack, 3-Lead  
 / TO-220F-3SG  
 CASE 221AT



### MARKING DIAGRAM



FDPF4D5N10C,  
 FQD45N10C = Specific Device Code  
 A = Assembly Location  
 YWW = Date Code (Year and Week)  
 ZZ = Assembly Lot Code

### ORDERING INFORMATION

Device	Package	Shipping†
FDPF4D5N10C	TO-220F (Pb-Free)	1000 Units / Tube
FDP4D5N10C	TO-220 (Pb-Free)	800 Units / Tube

†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](#).

# FDP4D5N10C,

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

Symbol	Parameter	Ratings		Units
		FDP4D5N10C	FDPF4D5N10C	
$V_{DS}$	Drain to Source Voltage	100	100	V
$V_{GS}$	Gate to Source Voltage	$\pm 20$	$\pm 20$	V
$I_D$	Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ ) (Note 3) - Continuous ( $T_C = 100^\circ\text{C}$ ) (Note 3) - Pulsed (Note 1)	128* 91 512	128* 91 512	A
$E_{AS}$	Single Pulsed-Avalanche Energy (Note 2)	486		mJ
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ )	150	37.5	W
	Power Dissipation ( $T_A = 25^\circ\text{C}$ )	2.4	2.4	
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +175	-55 to +175	$^\circ\text{C}$

\*Drain current limited by maximum junction temperature. Package limitation current is 120 A.  
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 CHARACTERISTICS

Symbol	Parameter	FDP4D5N10C	FDPF4D5N10C	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	1.0	4.0	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	62.5	62.5	

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 250 \mu\text{A}, V_{GS} = 0 \text{ V}$	100	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250 \mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	53	-	$\text{mV}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 80 \text{ V}, V_{GS} = 0 \text{ V}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 80 \text{ V}, T_J = 150^\circ\text{C}$	-	-	500	$\mu\text{A}$
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = \pm 20 \text{ V}, V_{DS} = 0 \text{ V}$	-	-	$\pm 100$	nA
<b>On Characteristics</b>						
$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = 310 \mu\text{A}$	2.0	3.2	4.0	V
$R_{DS(on)}$	Static Drain to Source On-Resistance	$V_{GS} = 10 \text{ V}, I_D = 100 \text{ A}$	-	4.0	4.5	$\text{m}\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 5 \text{ V}, I_D = 100 \text{ A}$	-	134	-	S
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 50 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	-	3615	5065	pF
$C_{oss}$	Output Capacitance		-	2330	3265	pF
$C_{rss}$	Reverse Transfer Capacitance		-	18	35	pF
$R_g$	Gate Resistance		0.1	1.1	2.2	S
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 50 \text{ V}, I_D = 100 \text{ A}, V_{GS} = 10 \text{ V}, R_{GEN} = 6 \Omega$	-	29	47	ns
$t_r$	Rise Time		-	49	79	ns
$t_{d(off)}$	Turn-Off Delay Time		-	41	66	ns
$t_f$	Fall Time		-	13	24	ns
$Q_g$	Total Gate Charge	$V_{GS} = 0 \text{ V to } 10 \text{ V}, V_{DD} = 50 \text{ V}, I_D = 100 \text{ A}$	-	48	68	nC
$Q_{gs}$	Gate to Source Gate Charge		-	19	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		-	9	-	nC
$Q_{oss}$	Output Charge	$V_{DD} = 50 \text{ V}, V_{GS} = 0 \text{ V}$	-	150	-	nC

## FDP4D5N10C,

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>Drain-Source Diode Characteristics</b>						
$I_S$	Maximum Continuous Drain to Source Diode Forward Current		-	-	128	A
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current		-	-	512	A
$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 100\text{ A}$	-	1.0	1.3	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, V_{DD} = 50\text{ V},$ $I_F = 100\text{ A}, dI_F/dt = 100\text{ A}/\mu\text{s}$	-	82	132	ns
$Q_{rr}$	Reverse Recovery Charge		-	106	170	nC
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, V_{DD} = 50\text{ V},$ $I_F = 100\text{ A}, dI_F/dt = 300\text{ A}/\mu\text{s}$	-	71	114	ns
$Q_{rr}$	Reverse Recovery Charge		-	258	413	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.

#### NOTES:

1. Pulsed  $I_d$  please refer to Figure "Forward Bias Safe Operating Area" for more details.
2.  $E_{AS}$  of 486 mJ is based on starting  $T_J = 25^\circ\text{C}$ ,  $L = 3\text{ mH}$ ,  $I_{AS} = 18\text{ A}$ ,  $V_{DD} = 100\text{ V}$ ,  $V_{GS} = 10\text{ V}$ . 100% test at  $L = 0.1\text{ mH}$ ,  $I_{AS} = 58\text{ A}$ .
3. Computed continuous current limited to Max Junction Temperature only, actual continuous current will be limited by thermal & electro-mechanical application board design.

# FDP4D5N10C,

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

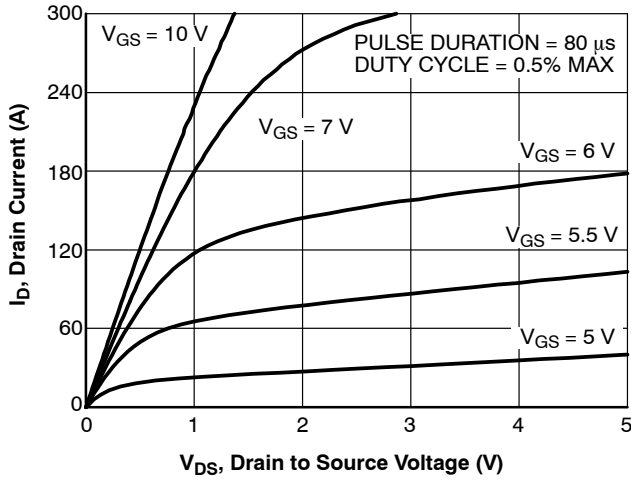


Figure 1. On-Region Characteristics

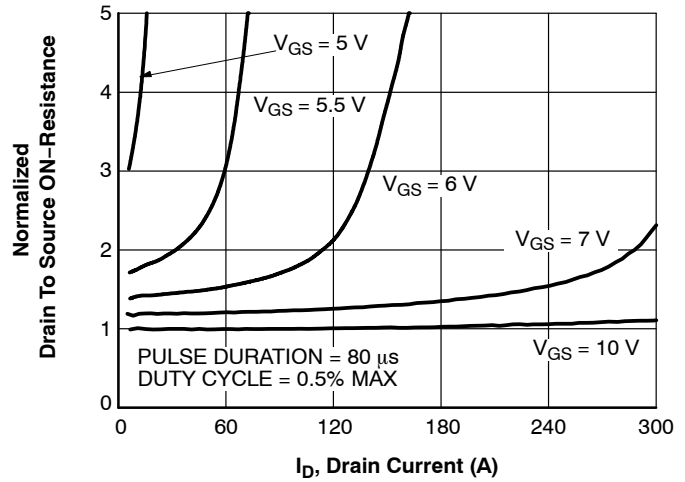


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

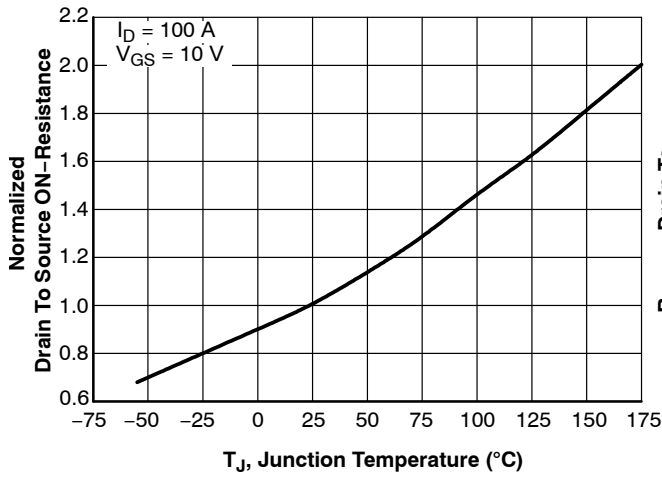


Figure 3. Normalized On Resistance vs. Junction Temperature

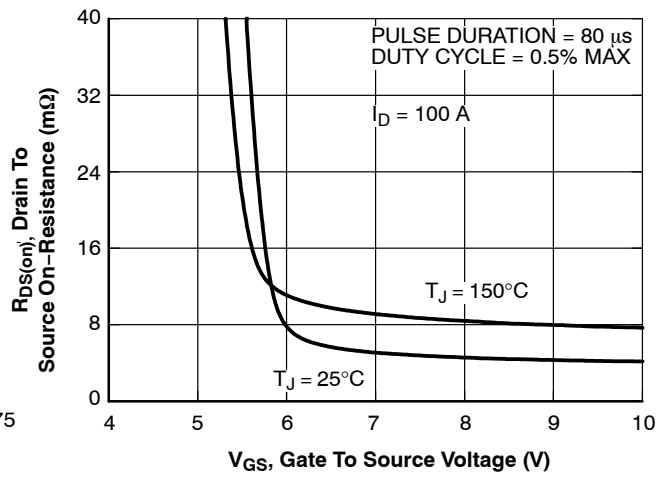


Figure 4. On-Resistance vs. Gate to Source Voltage

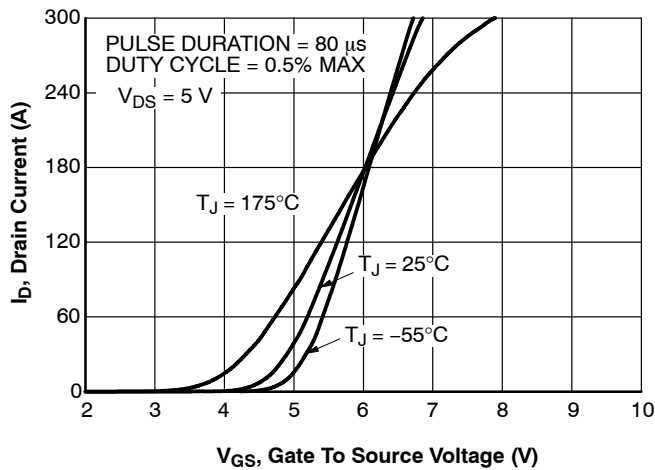


Figure 5. Transfer Characteristics

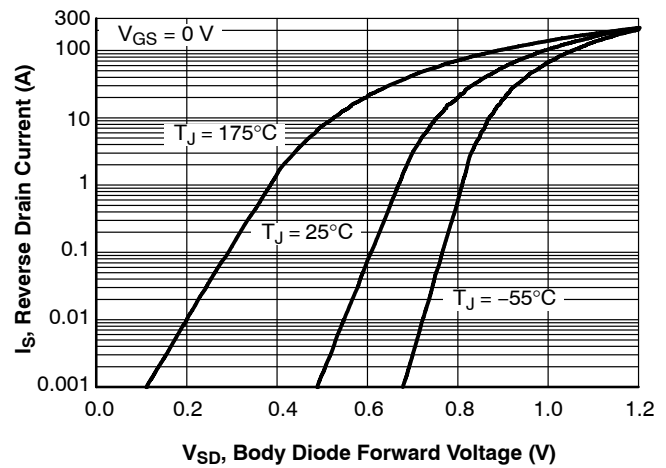


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

# FDP4D5N10C,

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

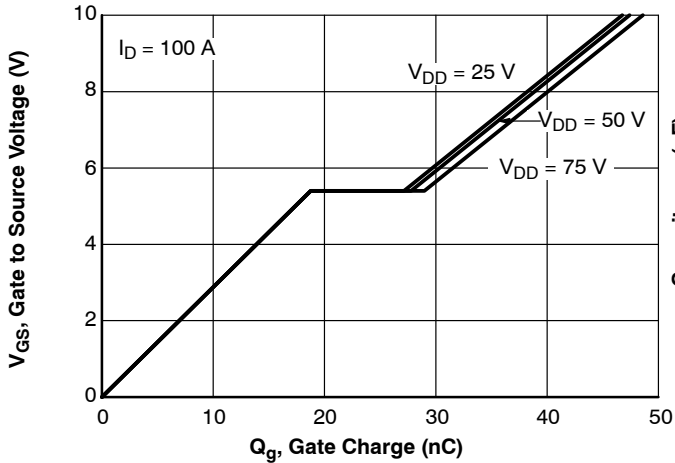


Figure 7. Gate Charge Characteristics

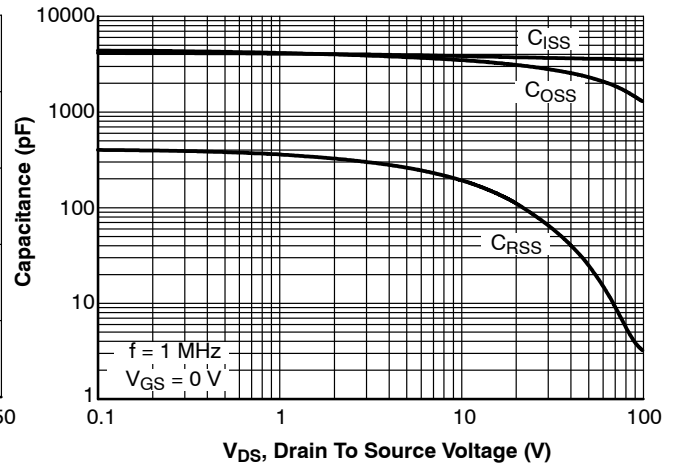


Figure 8. Capacitance vs Drain to Source Voltage

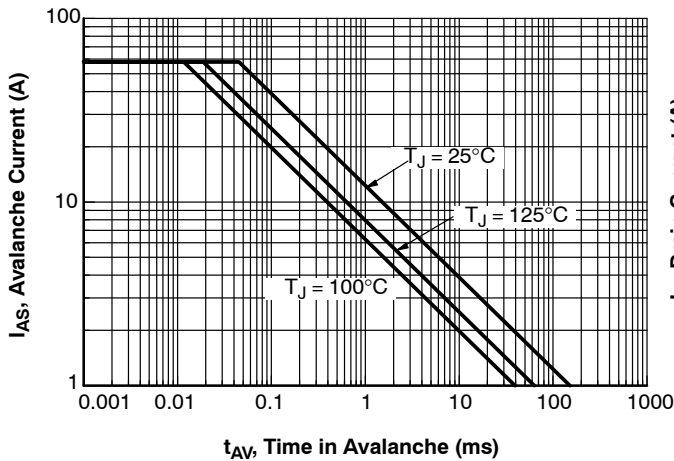


Figure 9. Unclamped Inductive Switching Capability

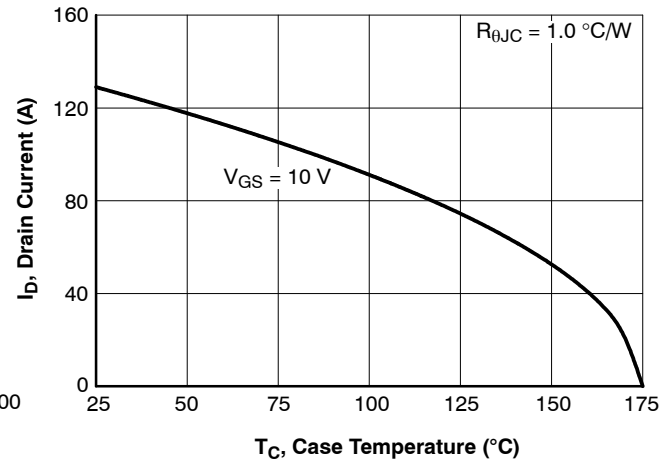


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

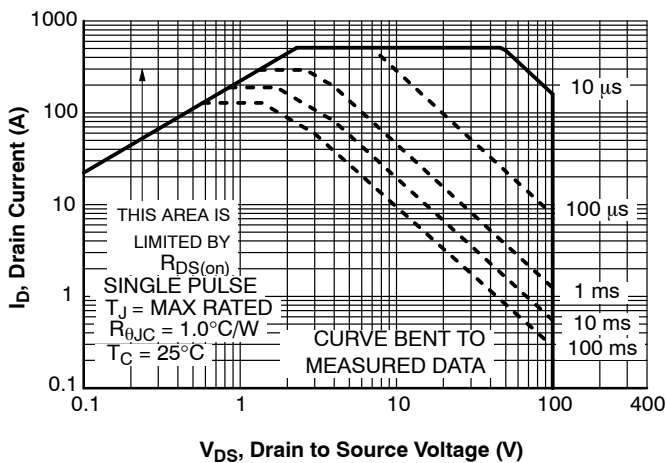


Figure 11. Forward Bias Safe Operating Area for FDP4D5N10C

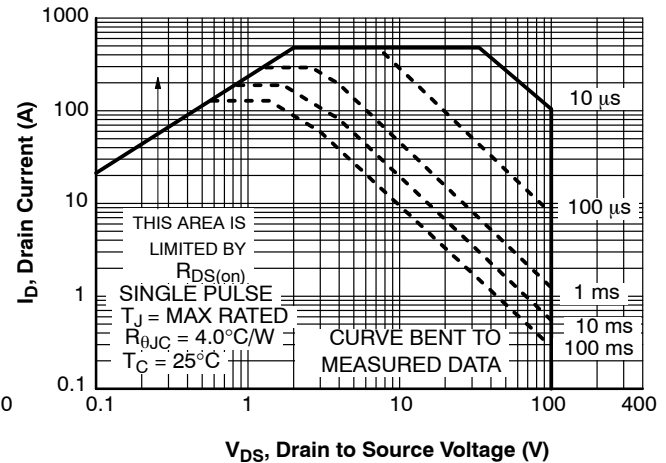


Figure 12. Forward Bias Safe Operating Area for FDP4D5N10C

# FDP4D5N10C,

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

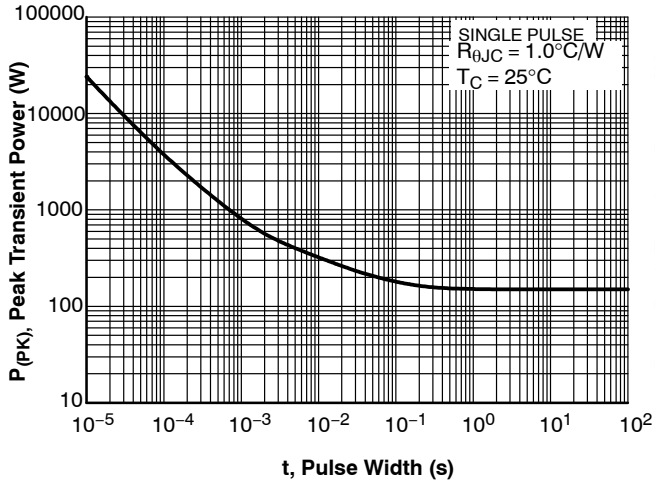


Figure 13. Single Pulse Maximum Power Dissipation for FDP4D5N10C

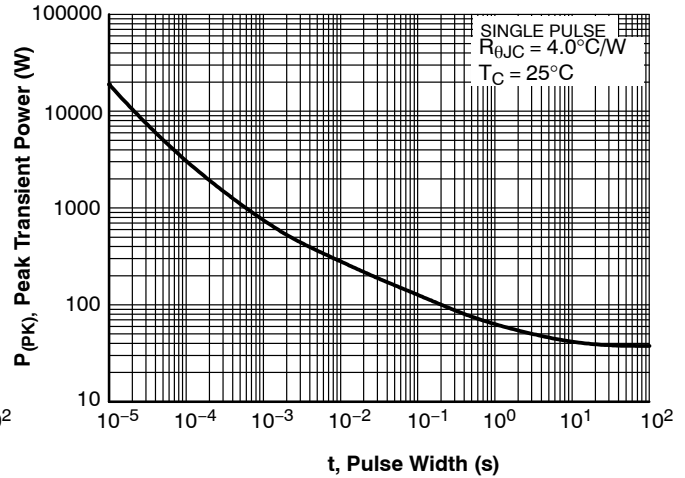


Figure 14. Single Pulse Maximum Power Dissipation for FDP4D5N10C

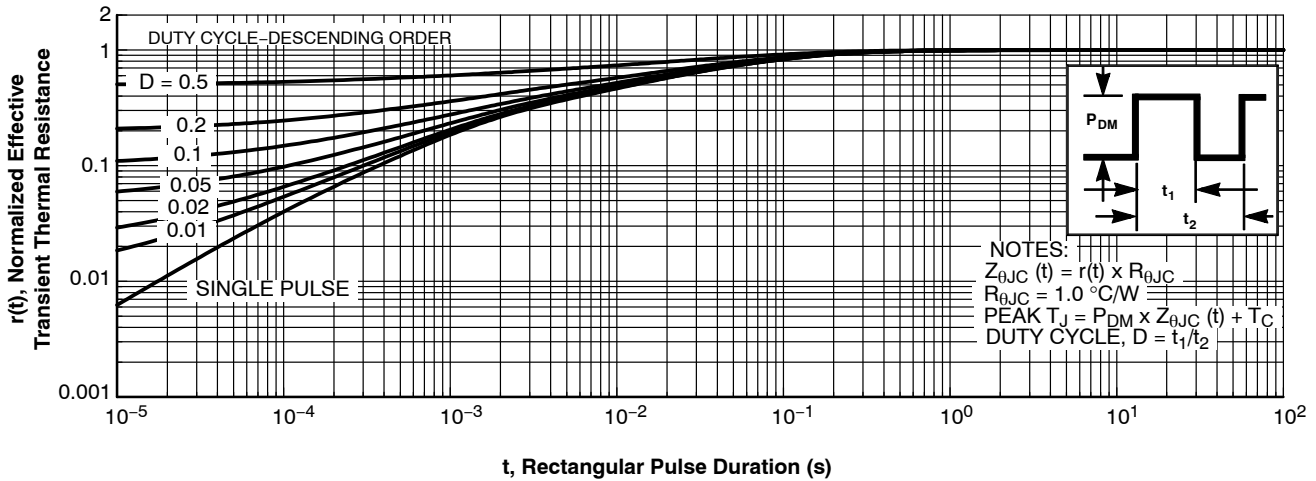


Figure 15. Junction-to-Case Transient Thermal Response Curve for FDP4D5N10C

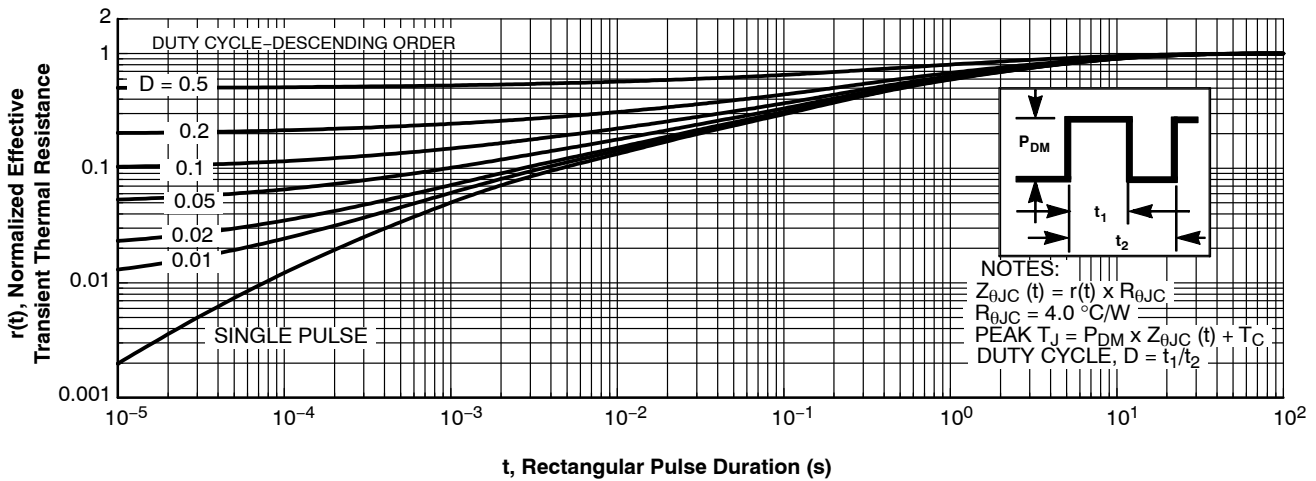
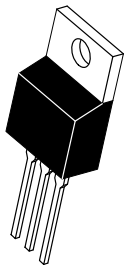
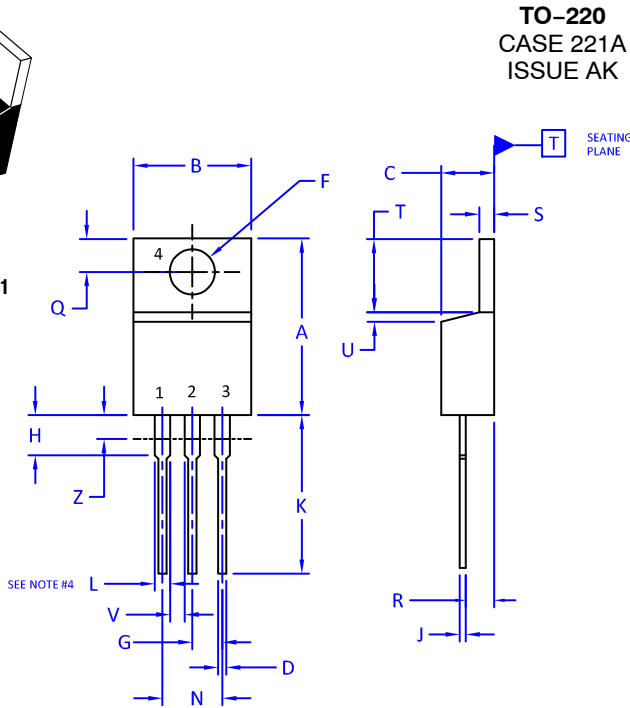


Figure 16. Junction-to-Case Transient Thermal Response Curve for FDP4D5N10C

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 1:1



## TO-220 CASE 221A ISSUE AK

DATE 13 JAN 2022

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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# MECHANICAL CASE OUTLINE

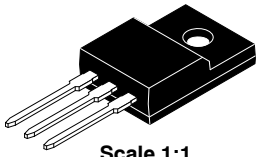
## PACKAGE DIMENSIONS

ON Semiconductor®

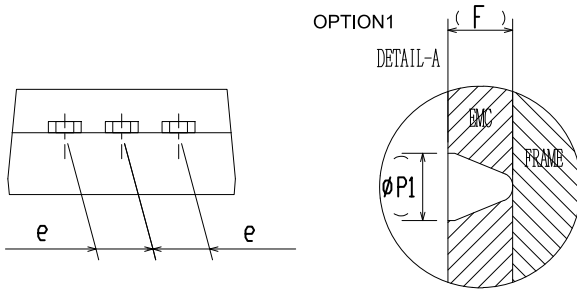
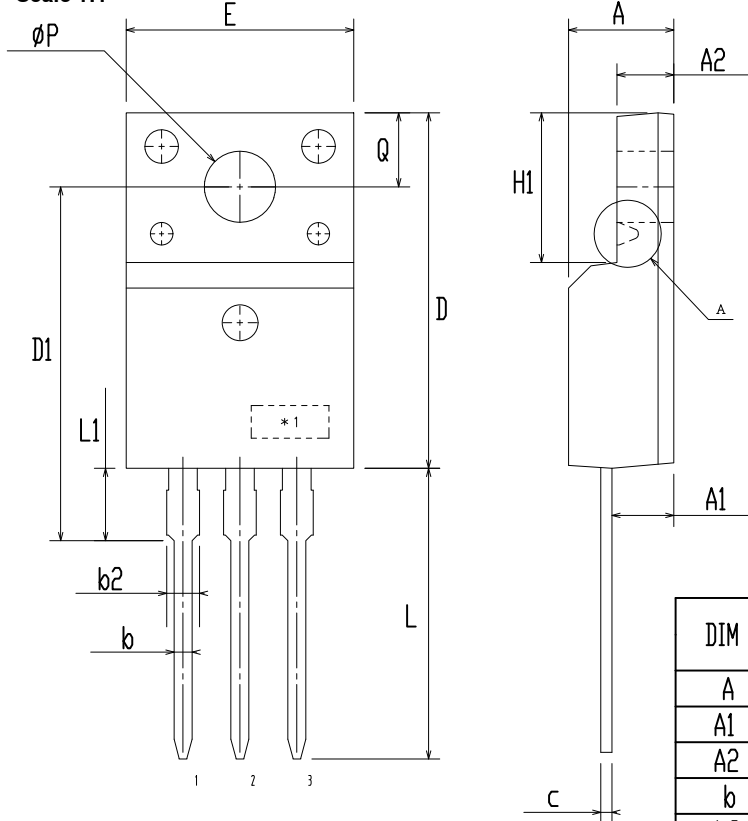


### TO-220 Fullpack, 3-Lead / TO-220F-3SG CASE 221AT ISSUE B

DATE 19 JAN 2021



Scale 1:1



DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.50	4.70	4.90
A1	2.56	2.76	2.96
A2	2.34	2.54	2.74
b	0.70	0.80	0.90
b2	~	~	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.60	15.80	16.00
E	9.96	10.16	10.36
e	2.34	2.54	2.74
F	~	0.84	~
H1	6.48	6.68	6.88
L	12.78	12.98	13.18
L1	3.03	3.23	3.43
phi P	2.98	3.18	3.38
phi P1	~	1.00	~
Q	3.20	3.30	3.40

**NOTES:**

- A. DIMENSION AND TOLERANCE AS ASME Y14.5-2009
- B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUCTIONS.
- C. OPTION 1 - WITH SUPPORT PIN HOLE  
OPTION 2 - NO SUPPORT PIN HOLE

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