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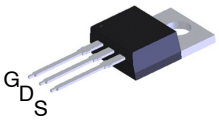
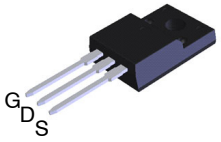
# MOSFET – N-Channel, Shielded Gate POWERTRENCH®

## 100 V, 128 A, 4.5 mΩ

# FDP4D5N10C, FDPF4D5N10C




TO−220
CASE 221A




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

### Description

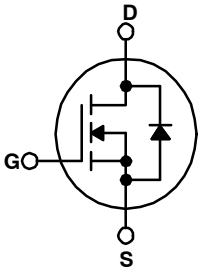
This N−Channel MV MOSFET is produced using **onsemi**'s advanced PowerTrench process that incorporates Shielded Gate technology. This Process has been Optimized to minimize on−state resistance and yet maintain superior switching performance with best in class soft body diode.

### Features

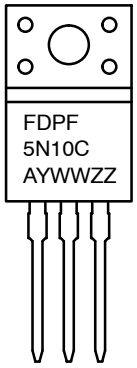
- Max $R_{DS(on)}$ = 4.5 mΩ at $V_{GS}$ = 10 V, $I_D$ = 100 A
- Extremely Low Reverse Recovery Charge, Qrr
- 100% UIL Tested
- This Device is Pb−Free Halide, Free and RoHS Compliant.

### Applications

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




### 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.

**MOSFET MAXIMUM RATINGS** ($T_C$ = 25°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 | ±20 | ±20 | V |
| $I_D$ | Drain Current<br>– Continuous ($T_C$ = 25°C) (Note 3)<br>– Continuous ($T_C$ = 100°C) (Note 3)<br>– Pulsed (Note 1) | <br>128*<br>91<br>512 | <br>128*<br>91<br>512 | A |
| $E_{AS}$ | Single Pulsed–Avalanche Energy (Note 2) | 486 | | mJ |
| $P_D$ | Power Dissipation ($T_C$ = 25°C) | 150 | 37.5 | W |
| | Power Dissipation ($T_A$ = 25°C) | 2.4 | 2.4 | |
| $T_J$,$T_{STG}$ | Operating and Storage Temperature Range | –55 to +175 | –55 to +175 | °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 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 62.5 | 62.5 | |

**ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = 250 μA, $V_{GS}$ = 0 V | 100 | – | – | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | – | 53 | – | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 80 V, $V_{GS}$ = 0 V | – | – | 1 | μA |
| | | $V_{DS}$ = 80 V, $T_J$ = 150°C | – | – | 500 | μA |
| $I_{GSS}$ | Gate to Source Leakage Current | $V_{GS}$ = ±20 V, $V_{DS}$ = 0 V | – | – | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 310 μA | 2.0 | 3.2 | 4.0 | V |
| $R_{DS(on)}$ | Static Drain to Source On–Resistance | $V_{GS}$ = 10 V, $I_D$ = 100 A | – | 4.0 | 4.5 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 5 V, $I_D$ = 100 A | – | 134 | – | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 50 V, $V_{GS}$ = 0 V, f = 1 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 |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn–On Delay Time | $V_{DD}$ = 50 V, $I_D$ = 100 A,<br>$V_{GS}$ = 10 V, $R_{GEN}$ = 6 Ω | – | 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 V to 10 V<br>$V_{DD}$ = 50 V, $I_D$ = 100 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 V, $V_{GS}$ = 0 V | – | 150 | – | nC |

**ELECTRICAL CHARACTERISTICS (continued)** ($T_J$ = 25°C unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Drain−Source Diode Characteristics** | | | | | | |
| $I_S$ | 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 V, $I_S$ = 100 A | – | 1.0 | 1.3 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $V_{DD}$ = 50 V, $I_F$ = 100 A, $dI_F/dt$ = 100 A/μs | – | 82 | 132 | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | – | 106 | 170 | nC |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $V_{DD}$ = 50 V, $I_F$ = 100 A, $dI_F/dt$ = 300 A/μs | – | 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 Id 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°C, L = 3 mH, $I_{AS}$ = 18 A, $V_{DD}$ = 100 V, $V_{GS}$ = 10 V. 100% test at L = 0.1 mH, $I_{AS}$ = 58 A.
3. Computed continuous current limited to Max Junction Temperature only, actual continuous current will be limited by thermal & electro−mechanical application board design.

## TYPICAL CHARACTERISTICS ($T_J$ = 25°C unless otherwise noted)

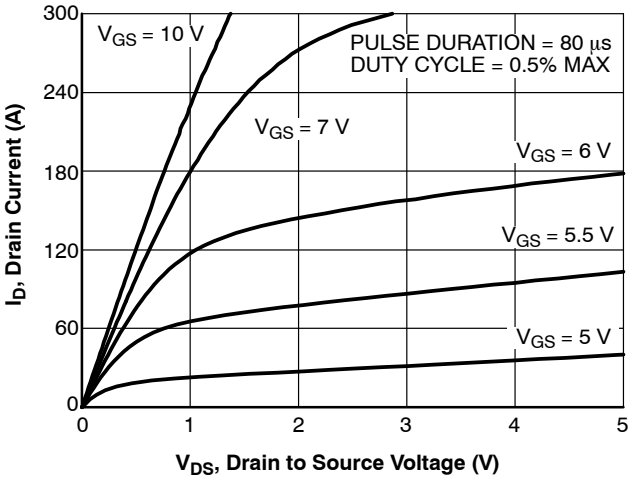



**Figure 1. On−Region Characteristics**

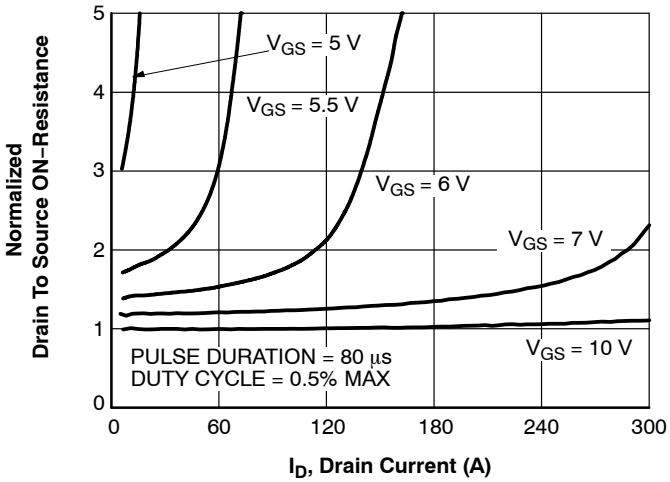



**Figure 2. Normalized On−Resistance vs Drain Current and Gate Voltage**

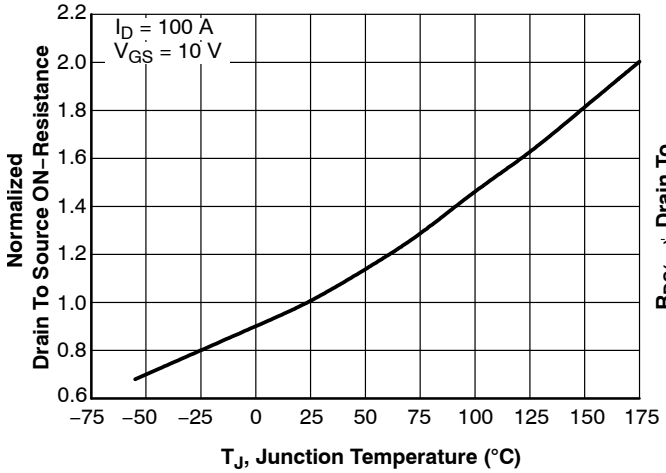



**Figure 3. Normalized On Resistance vs Junction Temperature**

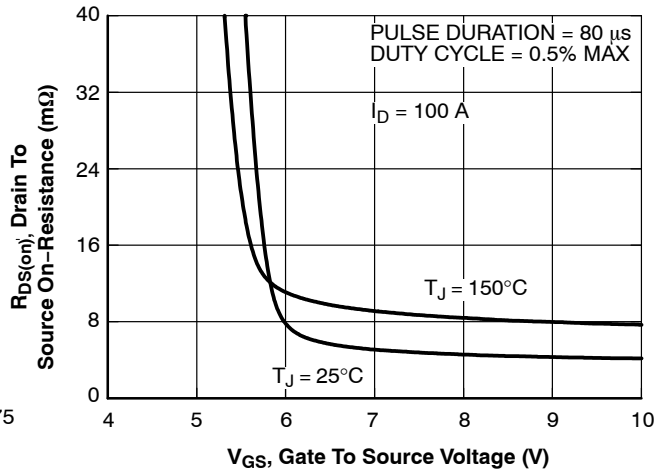



**Figure 4. On−Resistance vs. Gate to Source Voltage**

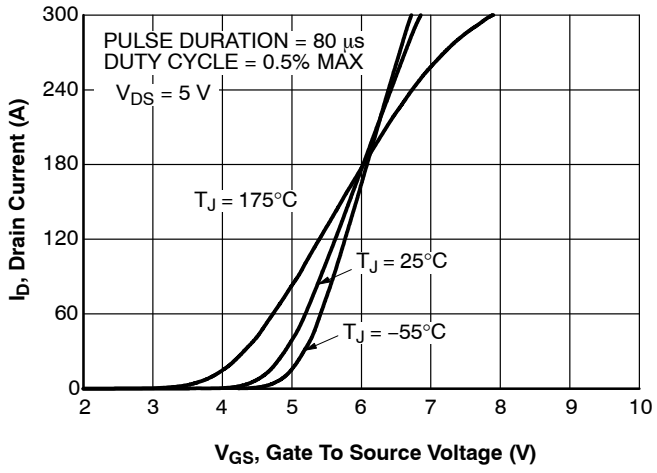



**Figure 5. Transfer Characteristics**

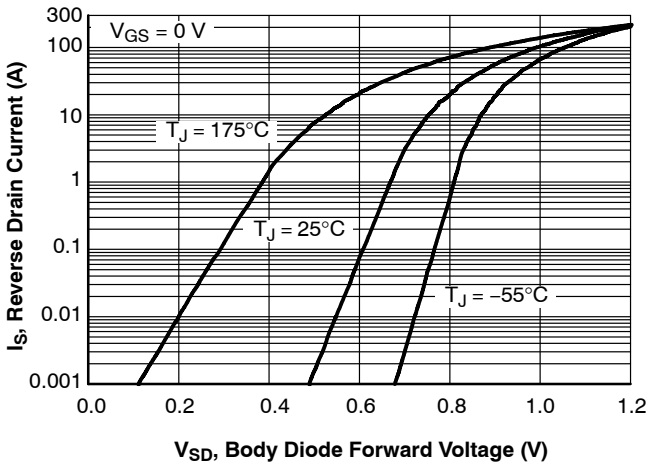



**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

**TYPICAL CHARACTERISTICS** (CONTINUED) ($T_J$ = 25°C unless otherwise noted)

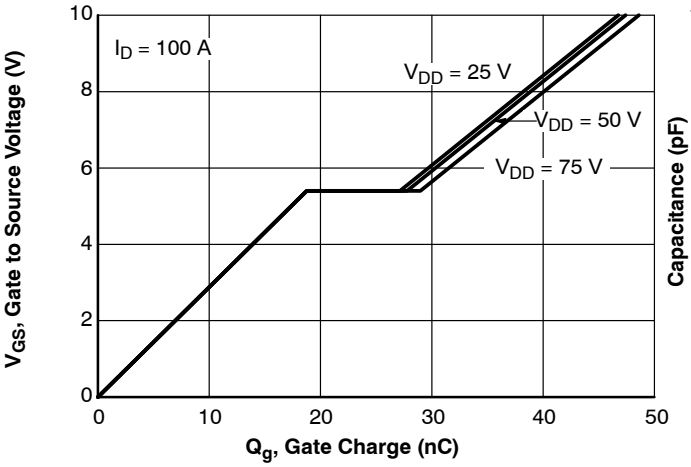



**Figure 7. Gate Charge Characteristics**

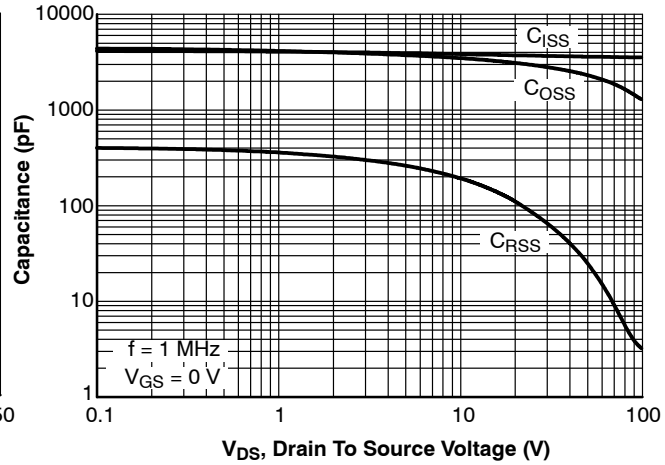



**Figure 8. Capacitance vs Drain to Source Voltage**

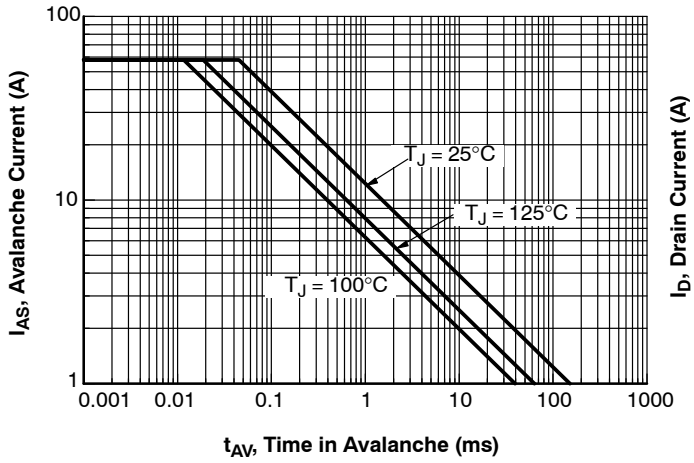



**Figure 9. Unclamped Inductive Switching Capability**

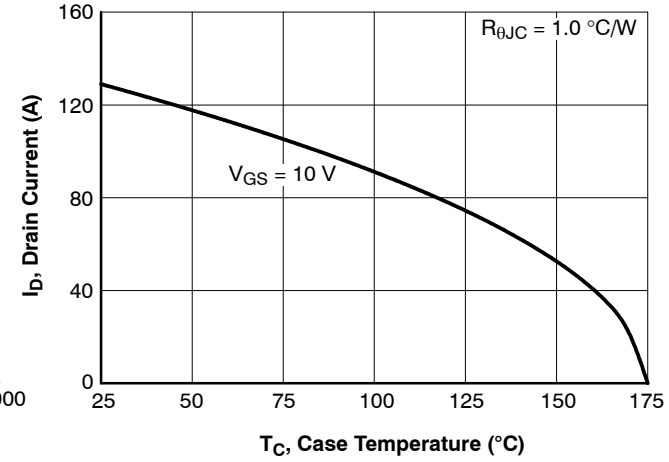



**Figure 10. Maximum Continous Drain Current vs. Case Temperature**

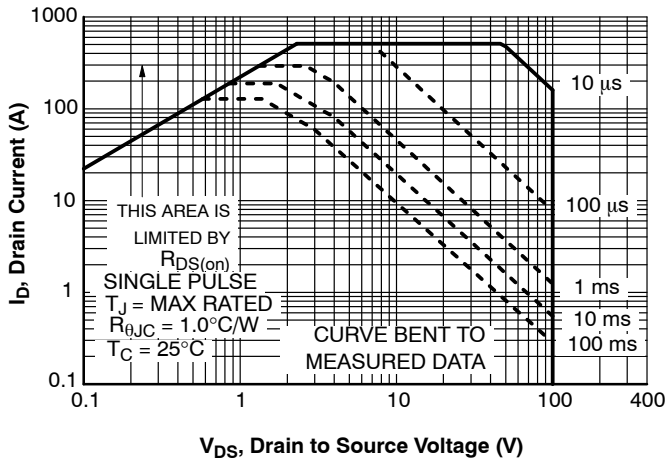



**Figure 11. Forward Bias Safe Operating Area for FDP4D5N10C**

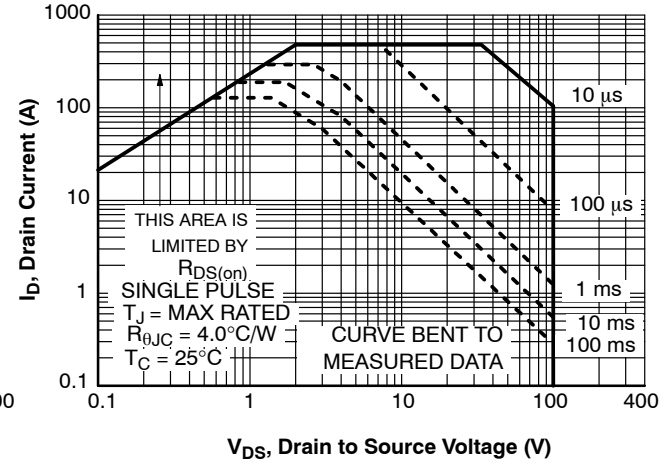



**Figure 12. Forward Bias Safe Operating Area for FDPF4D5N10C**

**TYPICAL CHARACTERISTICS** (CONTINUED) ($T_J$ = 25°C unless otherwise noted)

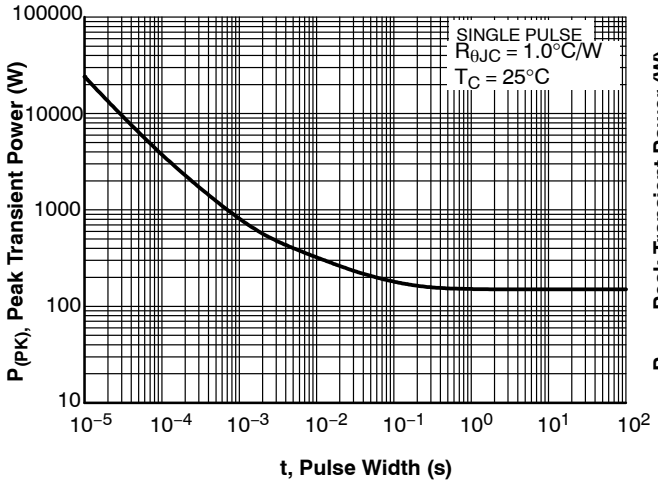



**Figure 13. Single Pulse Maximum Power Dissipation for FDP4D5N10C**

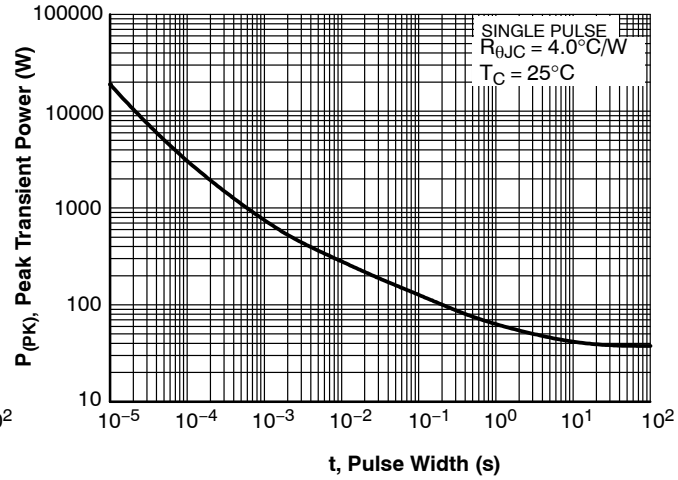



**Figure 14. Single Pulse Maximum Power Dissipation for FDPF4D5N10C**

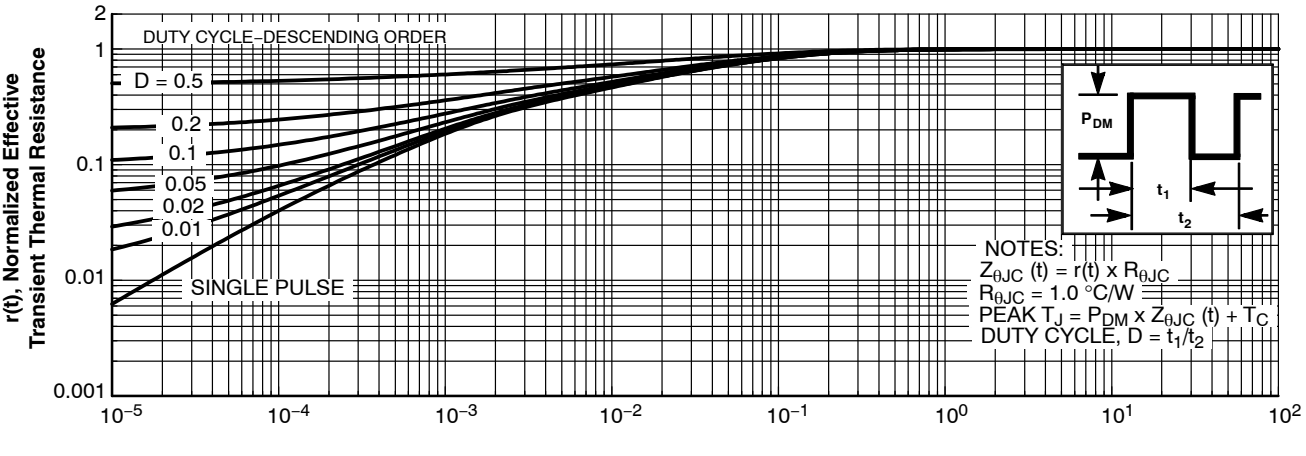



**Figure 15. Junction−to−Case Transient Thermal Response Curve for FDP4D5N10C**

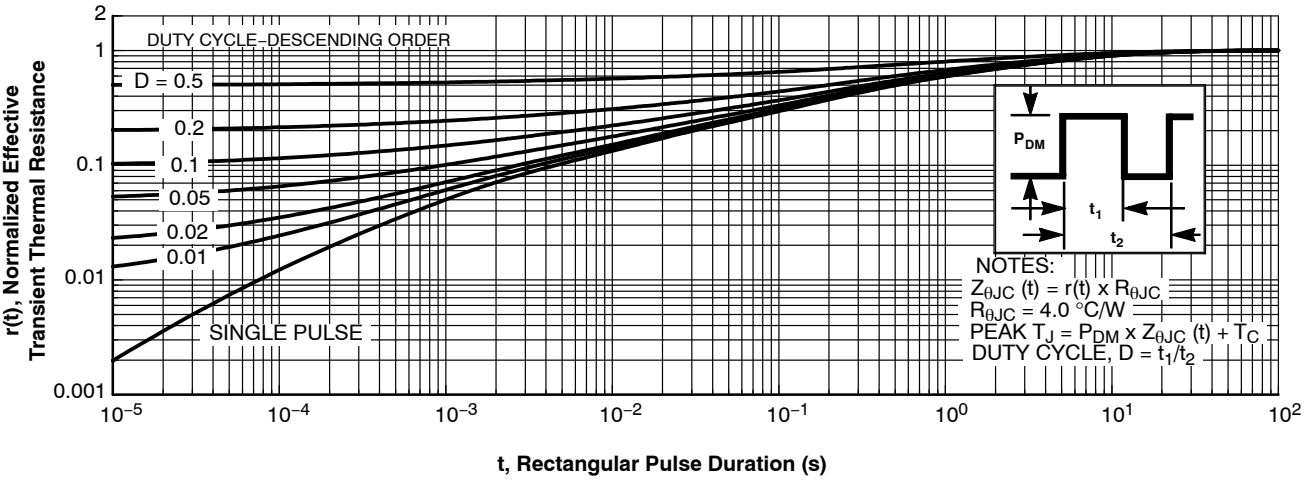
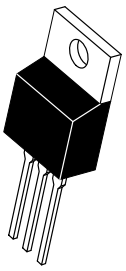


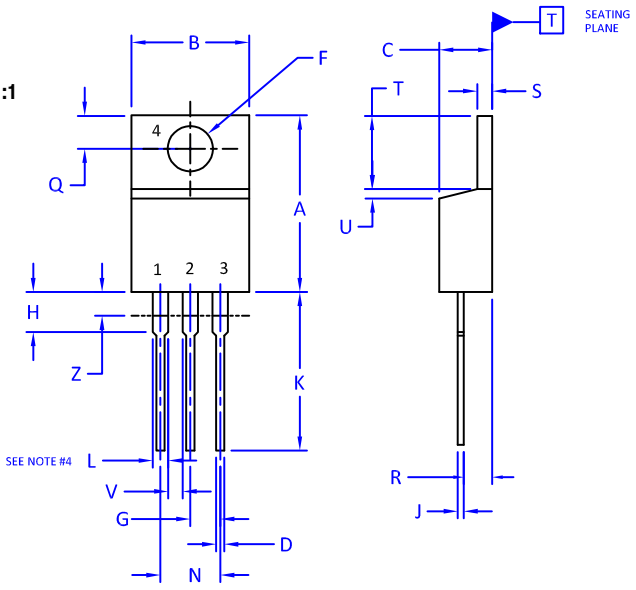

**Figure 16. Junction−to−Case Transient Thermal Response Curve for FDPF4D5N10C**

**TO−220**
CASE 221A
ISSUE AK

DATE 13 JAN 2022



**SCALE 1:1**




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

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | 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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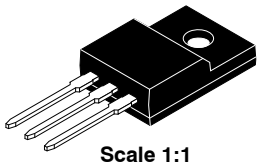
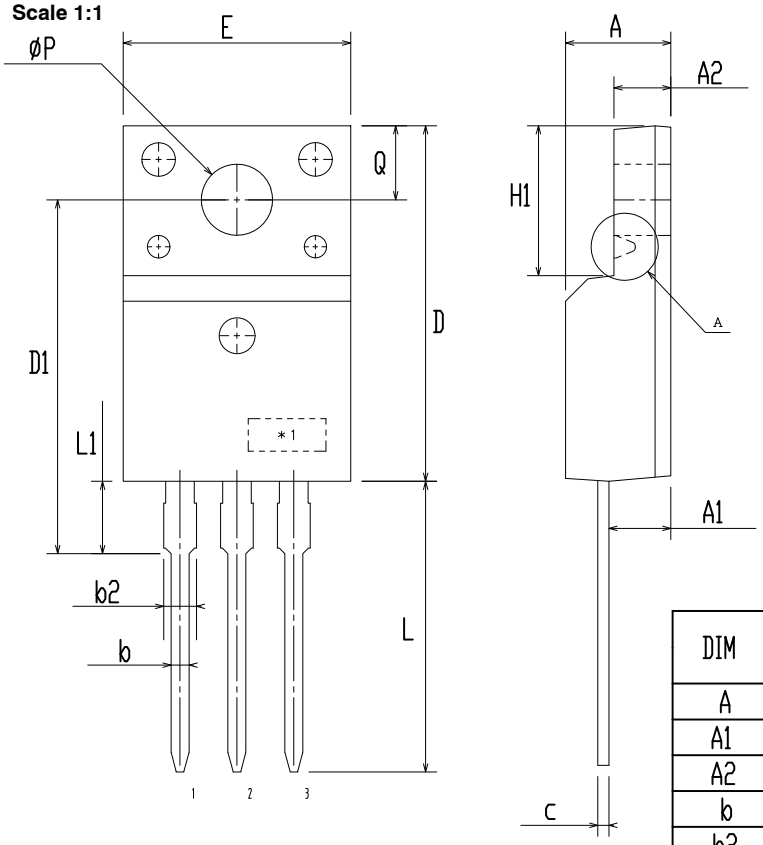
| **DESCRIPTION:** | **TO−220** | **PAGE 1 OF 1** |

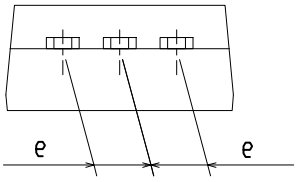
**TO−220 Fullpack, 3−Lead / TO−220F−3SG**
CASE 221AT
ISSUE B

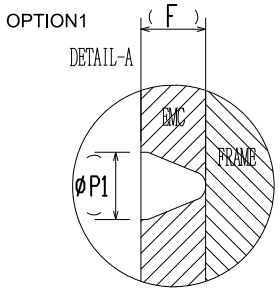
DATE 19 JAN 2021



**Scale 1:1**




| DIM | MILLIMITERS | | |
|---|---|---|---|
| | 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 |
| ø P | 2.98 | 3.18 | 3.38 |
| ø 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 PROTRUCSIONS.
C. OPTION 1 - WITH SUPPORT PIN HOLE
OPTION 2 - NO SUPPORT PIN HOLE

| | | | |
|---|---|---|---|
| **DOCUMENT NUMBER:** | **98AON67439E** | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. | |
| **DESCRIPTION:** | **TO−220 FULLPACK, 3−LEAD / TO−220F−3SG** | | **PAGE 1 OF 1** |

## ADDITIONAL INFORMATION

**TECHNICAL PUBLICATIONS**:
**Technical Library:** www.onsemi.com/design/resources/technical−documentation
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