

# MOSFET – N-Channel, Shielded Gate POWER trench®

100 V, 222 A, 2.3 mΩ

FDP2D3N10C,  
FDPF2D3N10C

## General Description

This N-Channel MV MOSFET is produced using onsemi's advanced POWER trench 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

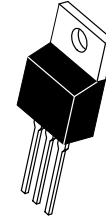
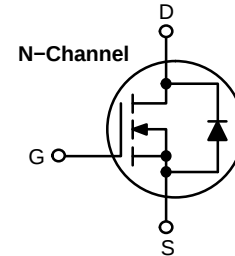
- Max  $r_{DS(on)}$  = 2.3 mΩ at  $V_{GS}$  = 10 V,  $I_D$  = 100 A
- Extremely Low Reverse Recovery Charge,  $Q_{rr}$
- 100% UIL Tested
- RoHS Compliant

## Applications

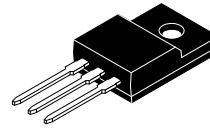
- Synchronous Rectification for ATX / Server / Telecom PSU
- Motor Drives and Uninterruptible Power Supplies
- Micro Solar Inverter

| $V_{DS}$ | $r_{DS(on)}$ MAX | $I_D$ MAX |
|----------|------------------|-----------|
| 100 V    | 2.3 mΩ @ 10 V    | 222 A*    |

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

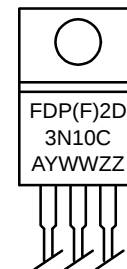


TO-220  
CASE 221A



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

## MARKING DIAGRAM



FDP(F)2D3N10C = Specific Device Code  
A = Assembly Location  
YWW = Date Code (Year & Week)  
ZZ = Assembly Lot

## ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

# FDP2D3N10C, FDPF2D3N10C

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

| Symbol         | Parameter                                        |                                                  | Rating          |             | Unit             |
|----------------|--------------------------------------------------|--------------------------------------------------|-----------------|-------------|------------------|
|                |                                                  |                                                  | FDP2D3N10C      | FDPF2D3N10C |                  |
| $V_{DS}$       | 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)  | 222*            | 222*        | A                |
|                |                                                  | – Continuous, $T_C = 100^\circ\text{C}$ (Note 3) | 157*            | 157*        |                  |
|                |                                                  | – Pulsed (Note 1)                                | 888             | 888         | A                |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)          |                                                  | 1176            |             | mJ               |
| $P_D$          | Power Dissipation                                | $T_C = 25^\circ\text{C}$                         | 214             | 45          | W                |
|                |                                                  | $T_A = 25^\circ\text{C}$                         | 2.4             | 2.4         |                  |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range |                                                  | $-55$ to $+175$ |             | $^\circ\text{C}$ |

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.

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

1. Pulsed  $I_D$  please refer to Figure 11 and Figure 12 "Forward Bias Safe Operating Area" for more details.
2.  $E_{AS}$  of 1176 mJ is based on starting  $T_J = 25^\circ\text{C}$ ,  $L = 3$  mH,  $I_{AS} = 28$  A,  $V_{DD} = 90$  V,  $V_{GS} = 10$  V. 100% test at  $L = 0.1$  mH,  $I_{AS} = 89$  A.
3. Computed continuous current limited to Max Junction Temperature only, actual continuous current will be limited by thermal & electro-mechanical application board design.

## THERMAL CHARACTERISTICS

| Symbol          | Parameter                                     | FDP2D3N10C | FDPF2D3N10C | Unit               |
|-----------------|-----------------------------------------------|------------|-------------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max.    | 0.7        | 3.3         | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 62.5       | 62.5        |                    |

## PACKAGE MARKING AND ORDERING INFORMATION

| Device Marking | Device      | Package | Shipping           |
|----------------|-------------|---------|--------------------|
| FDP2D3N10C     | FDP2D3N10C  | TO-220  | 800 units / Tube   |
| FDPF2D3N10C    | FDPF2D3N10C | TO-220F | 1,000 units / Tube |

# FDP2D3N10C, FDPF2D3N10C

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

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|--------|-----------|-----------------|-----|-----|-----|------|
|--------|-----------|-----------------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                      |                                           |                                                             |     |    |           |               |
|--------------------------------------|-------------------------------------------|-------------------------------------------------------------|-----|----|-----------|---------------|
| $BV_{DSS}$                           | 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 $25^\circ\text{C}$ | –   | 70 | –         | mV/°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            |

### ON CHARACTERISTICS

|              |                                      |                                                 |     |     |     |            |
|--------------|--------------------------------------|-------------------------------------------------|-----|-----|-----|------------|
| $V_{GS(th)}$ | Gate to Source Threshold Voltage     | $V_{GS} = V_{DS}$ , $I_D = 700\ \mu\text{A}$    | 2.0 | 3.0 | 4.0 | V          |
| $r_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\ \text{V}$ , $I_D = 100\ \text{A}$ | –   | 2.1 | 2.3 | m $\Omega$ |
| $g_{FS}$     | Forward Transconductance             | $V_{DS} = 5\ \text{V}$ , $I_D = 100\ \text{A}$  | –   | 222 | –   | S          |

### DYNAMIC CHARACTERISTICS

|           |                              |                                                                        |     |      |       |          |
|-----------|------------------------------|------------------------------------------------------------------------|-----|------|-------|----------|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = 50\ \text{V}$ , $V_{GS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$ | –   | 7980 | 11180 | pF       |
| $C_{oss}$ | Output Capacitance           |                                                                        | –   | 4490 | 6290  | pF       |
| $C_{rss}$ | Reverse Transfer Capacitance |                                                                        | –   | 40   | 75    | pF       |
| $R_g$     | Gate Resistance              |                                                                        | 0.1 | 0.8  | 1.8   | $\Omega$ |

### SWITCHING CHARACTERISTICS

|              |                               |                                                                                                   |   |     |     |    |
|--------------|-------------------------------|---------------------------------------------------------------------------------------------------|---|-----|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time            | $V_{DD} = 50\ \text{V}$ , $I_D = 100\ \text{A}$ , $V_{GS} = 10\ \text{V}$ , $R_{GEN} = 6\ \Omega$ | – | 42  | 67  | ns |
| $t_r$        | Rise Time                     |                                                                                                   | – | 35  | 56  | ns |
| $t_{d(off)}$ | Turn-Off Delay Time           |                                                                                                   | – | 74  | 118 | ns |
| $t_f$        | Fall Time                     |                                                                                                   | – | 32  | 57  | ns |
| $Q_g$        | Total Gate Charge             | $V_{GS} = 0\ \text{V}$ to $10\ \text{V}$ , $V_{DD} = 50\ \text{V}$ , $I_D = 100\ \text{A}$        | – | 108 | 152 | nC |
| $Q_{gs}$     | Gate to Source Gate Charge    | $V_{DD} = 50\ \text{V}$ , $I_D = 100\ \text{A}$                                                   | – | 36  | –   | nC |
| $Q_{gd}$     | Gate to Drain “Miller” Charge |                                                                                                   | – | 22  | –   | nC |
| $Q_{oss}$    | Output Charge                 | $V_{DD} = 50\ \text{V}$ , $V_{GS} = 0\ \text{V}$                                                  | – | 297 | –   | nC |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|          |                                                          |                                                                                                                  |   |     |     |    |
|----------|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|---|-----|-----|----|
| $I_S$    | Maximum Continuous Drain to Source Diode Forward Current |                                                                                                                  | – | –   | 222 | A  |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current     |                                                                                                                  | – | –   | 888 | A  |
| $V_{SD}$ | Source to Drain Diode Forward Voltage                    | $V_{GS} = 0\ \text{V}$ , $I_{SD} = 100\ \text{A}$                                                                | – | 0.9 | 1.3 | V  |
| $t_{rr}$ | Reverse Recovery Time                                    | $V_{GS} = 0\ \text{V}$ , $V_{DD} = 50\ \text{V}$ , $I_F = 100\ \text{A}$ , $dI_F/dt = 100\ \text{A}/\mu\text{s}$ | – | 107 | 172 | ns |
| $Q_{rr}$ | Reverse Recovery Charge                                  |                                                                                                                  | – | 191 | 306 | nC |
| $t_{rr}$ | Reverse Recovery Time                                    | $V_{GS} = 0\ \text{V}$ , $V_{DD} = 50\ \text{V}$ , $I_F = 100\ \text{A}$ , $dI_F/dt = 300\ \text{A}/\mu\text{s}$ | – | 97  | 155 | ns |
| $Q_{rr}$ | Reverse Recovery Charge                                  |                                                                                                                  | – | 492 | 788 | 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.

# FDP2D3N10C, FDPF2D3N10C

## TYPICAL PERFORMANCE CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED)

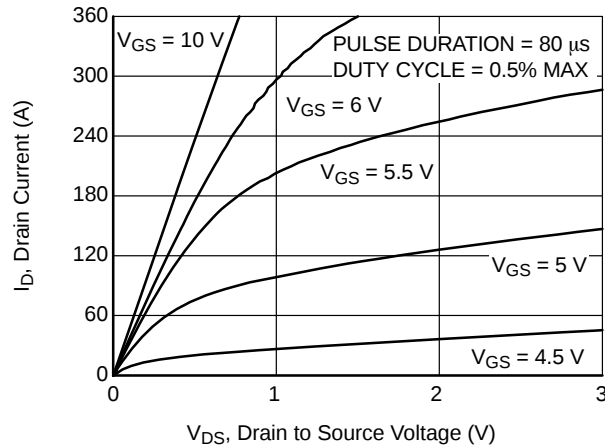


Figure 1. On-Region Characteristics

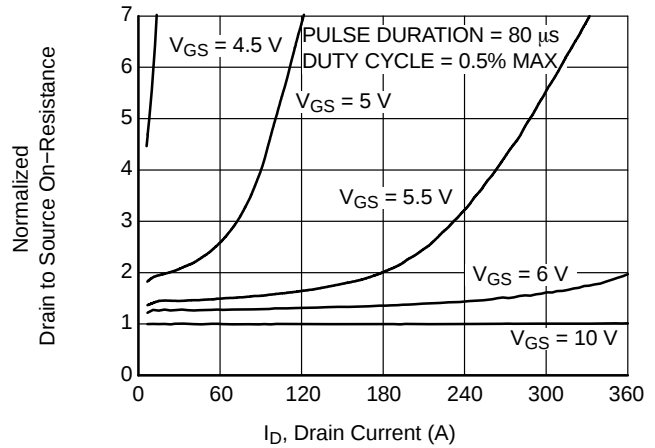


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

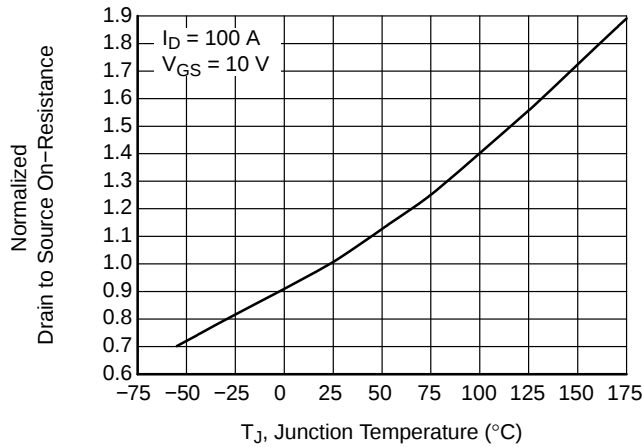


Figure 3. Normalized On-Resistance vs. Junction Temperature

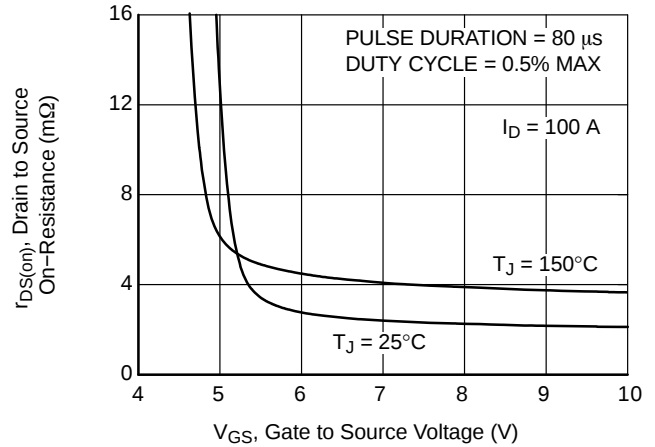


Figure 4. On-Resistance vs. Gate to Source Voltage

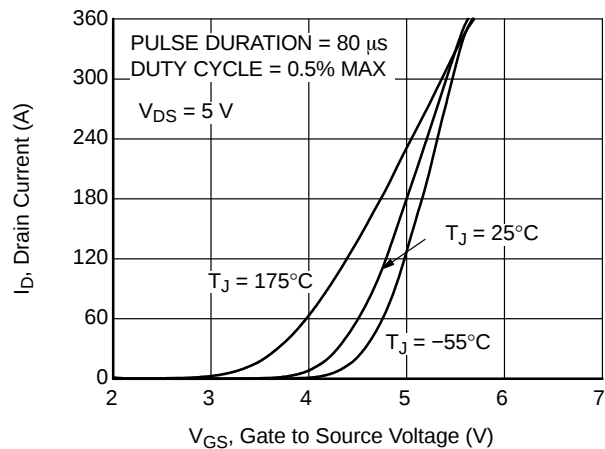


Figure 5. Transfer Characteristics

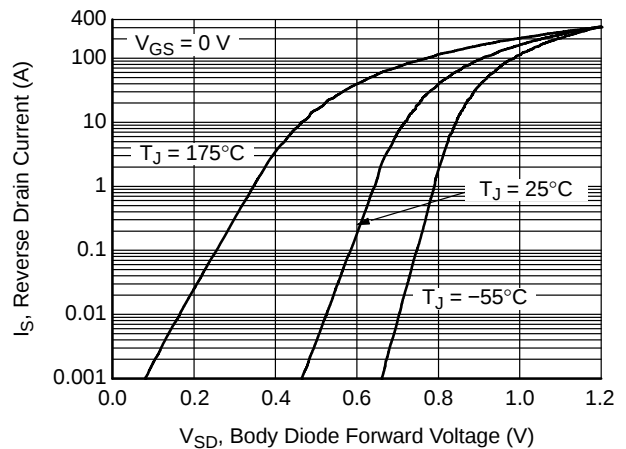


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

# FDP2D3N10C, FDPF2D3N10C

## TYPICAL PERFORMANCE CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED) (CONTINUED)

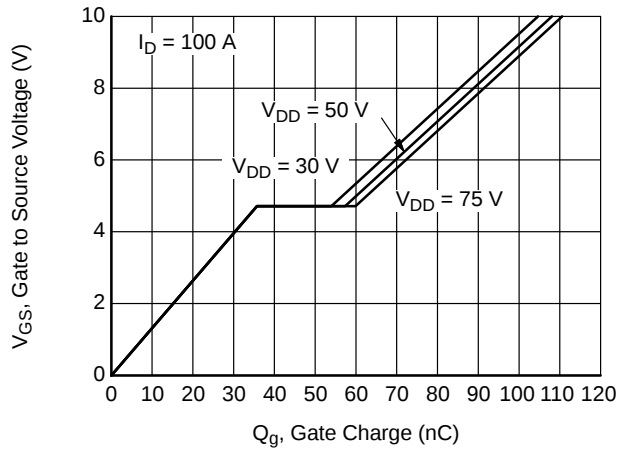


Figure 7. Gate Charge Characteristics

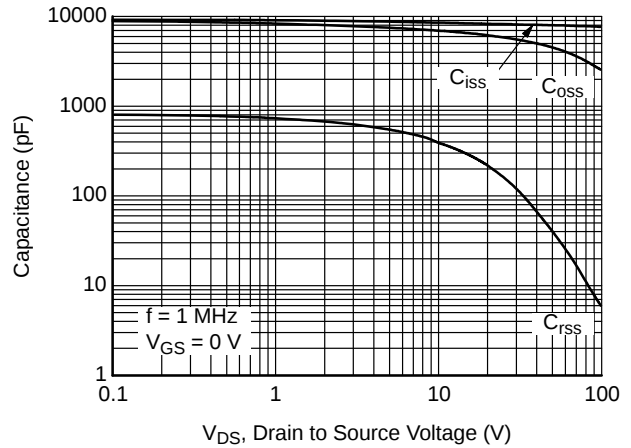


Figure 8. Capacitance vs. Drain to Source Voltage

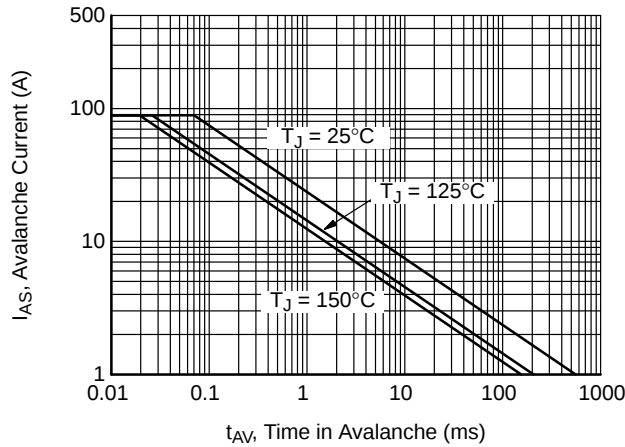


Figure 9. Unclamped Inductive Switching Capability

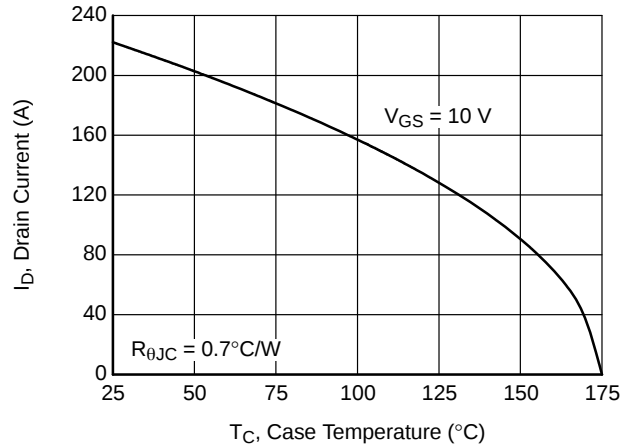


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

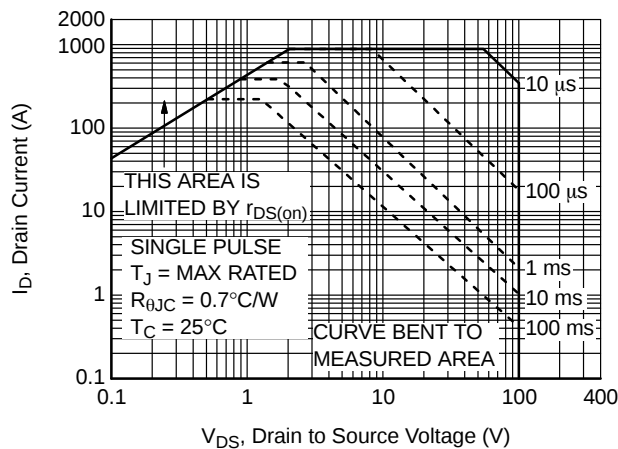


Figure 11. Forward Bias Safe Operating Area for FDP2D3N10C

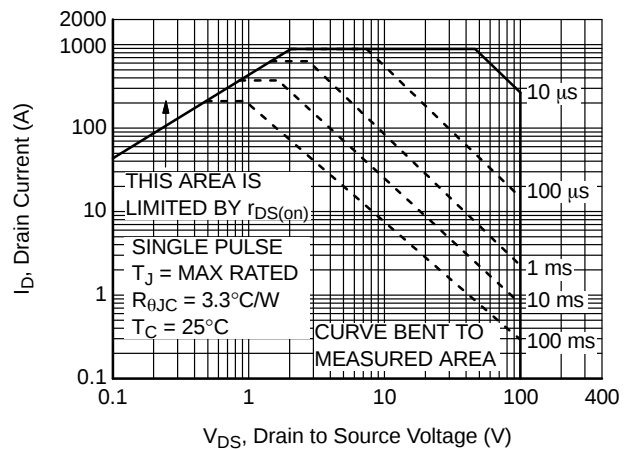


Figure 12. Forward Bias Safe Operating Area for FDPF2D3N10C

# FDP2D3N10C, FDPF2D3N10C

TYPICAL PERFORMANCE CHARACTERISTICS ( $T_J = 25^\circ\text{C}$  UNLESS OTHERWISE NOTED) (CONTINUED)

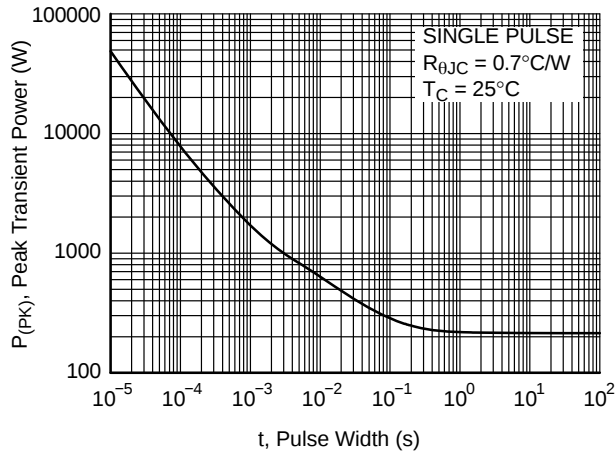


Figure 13. Single Pulse Maximum Power Dissipation for FDP2D3N10C

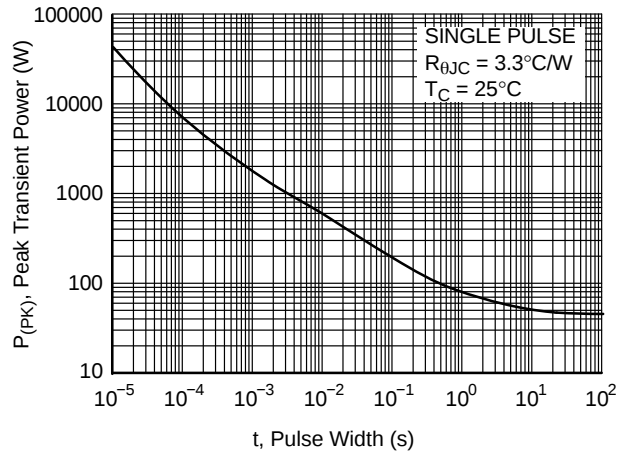


Figure 14. Single Pulse Maximum Power Dissipation for FDPF2D3N10C

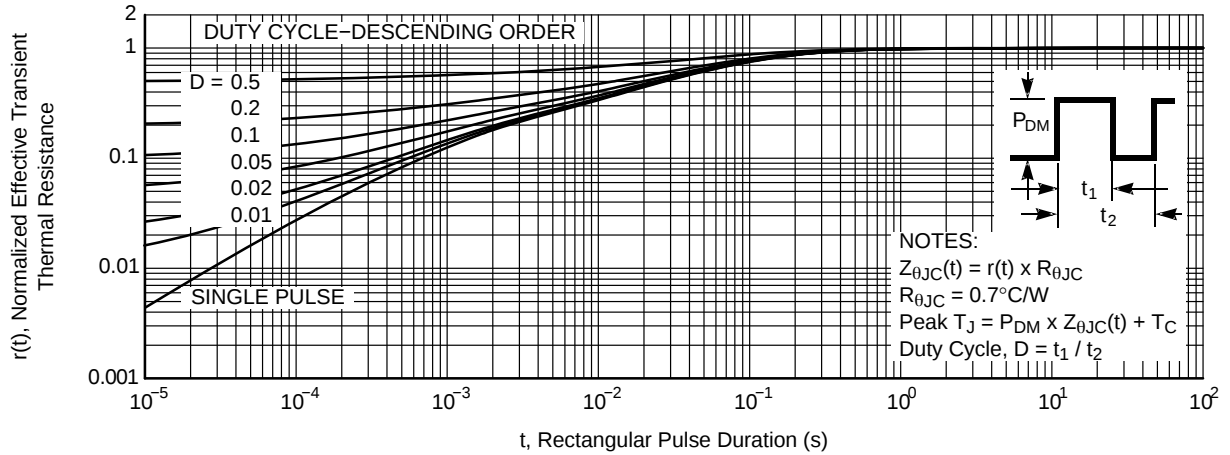


Figure 15. Junction-to-Case Transient Thermal Response Curve for FDP2D3N10C

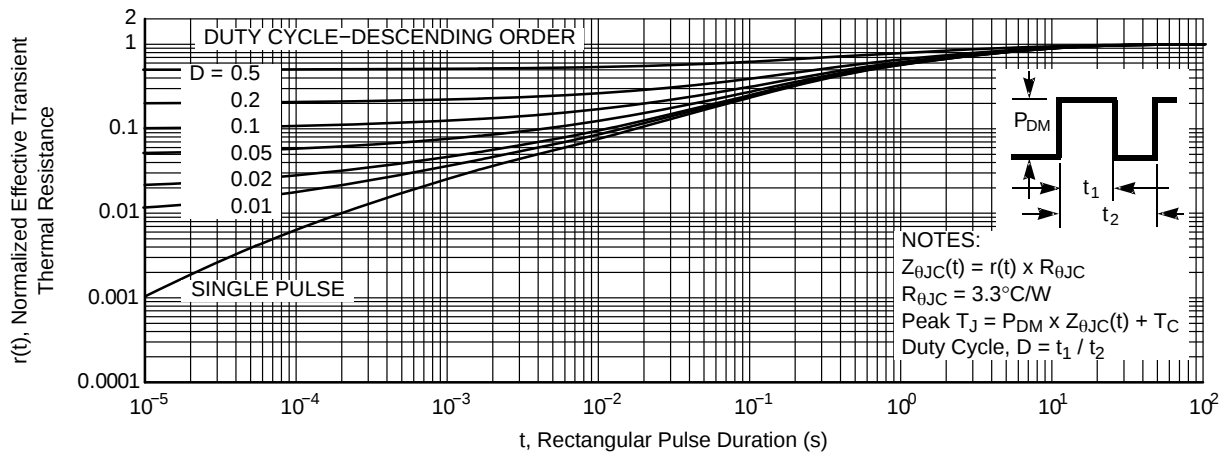
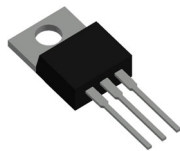


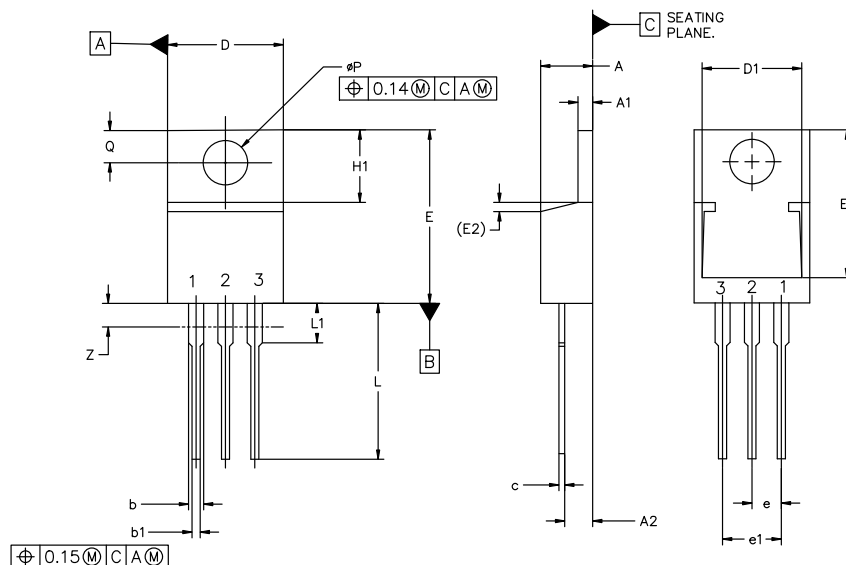
Figure 16. Junction-to-Case Transient Thermal Response Curve for FDPF2D3N10C

## FDP2D3N10C, FDPF2D3N10C

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**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  |
| $\phi P$    | 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.

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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| <b>DESCRIPTION:</b>     | <b>TO-220-3 10.10x15.12x4.45, 2.54P</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

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

DATE 19 JAN 2021



Scale 1:1



OPTION1



| 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  |
| 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 PROTRUCTIONS.

C. OPTION 1 - WITH SUPPORT PIN HOLE

OPTION 2 - NO SUPPORT PIN HOLE

|                         |                                              |                                                                                                                                                                                     |
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| <b>DESCRIPTION:</b>     | <b>TO-220 FULLPACK, 3-LEAD / TO-220F-3SG</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                                  |

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