# MOSFET – N-Channel, UNIFET™

## 250 V, 51 A, 60 mΩ

# FDP51N25, FDPF51N25

| $V_{DSS}$ | $R_{DS(on)}$ MAX | $I_D$ MAX |
|---|---|---|
| 250 V | 60 mΩ @ 10 V | 51 A |

### Description

UniFET MOSFET is **onsemi**'s high voltage MOSFET family based on planar stripe and DMOS technology. This MOSFET is tailored to reduce on−state resistance, and to provide better switching performance and higher avalanche energy strength. This device family is suitable for switching power converter applications such as power factor correction (PFC), flat panel display (FPD) TV power, ATX and electronic lamp ballasts.

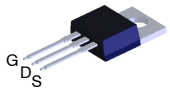
### Features

- $R_{DS(on)}$ = 48 mΩ (Typ.) @ $V_{GS}$ = 10 V, $I_D$ = 25.5 A
- Low Gate Charge (Typ. 55 nC)
- Low $C_{rss}$ (Typ. 63 pF)

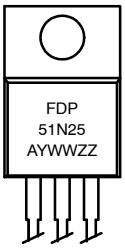
### Applications

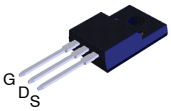
- PDP TV
- Lighting
- Uninterruptible Power Supply
- AC−DC Power Supply

### MARKING DIAGRAM

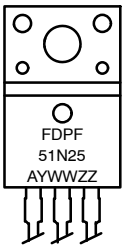



**TO−220−3LD**
**CASE 340AT**



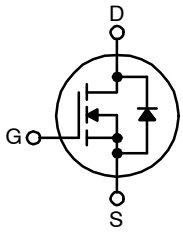




**TO−220 Fullpack, 3−Lead / TO−220F−3SG**
**CASE 221AT**




| | |
|---|---|
| FDP51N25, FDPF51N25 | = Specific Device Code |
| A | = Assembly Location |
| YWW | = Date Code (Year & Week) |
| ZZ | = Assembly Lot |

### N−CHANNEL MOSFET




### ORDERING INFORMATION

See detailed ordering and shipping information on page 9 of this data sheet.

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25°C unless otherwise noted)

| Symbol | Parameter | | FDP51N25 | FDPF51N25 | Unit |
|---|---|---|---|---|---|
| $V_{DSS}$ | Drain−Source Voltage | | 250 | | V |
| $I_D$ | Drain Current | − Continuous ($T_C$ = 25°C)<br>− Continuous ($T_C$ = 100°C) | 51<br>30 | 51*<br>30* | A<br>A |
| $I_{DM}$ | Drain Current | − Pulsed (Note 1) | 204 | 204* | A |
| $V_{GSS}$ | Gate−Source Voltage | | ±30 | | V |
| $E_{AS}$ | Single Pulsed Avalanche Energy (Note 2) | | 1111 | | mJ |
| $I_{AR}$ | Avalanche Current (Note 1) | | 51 | | A |
| $E_{AR}$ | Repetitive Avalanche Energy (Note 1) | | 32 | | mJ |
| $V_{ISO}$ | Insulation Withstand Voltage (RMS) from All Three Leads to External Heat Sink (t = 0.3 s; $T_C$ = 25°C) | | N/A | 2500 | V |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | | 4.5 | | V/ns |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C)<br>− Derate Above 25°C | 320<br>3.7 | 38<br>0.3 | W<br>W/°C |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | −55 to +150 | | °C |
| $T_L$ | Maximum Lead Temperature for Soldering, 1/8” from Case for 5 Seconds | | 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.
*Drain current limited by maximum junction temperature.
1. Repetitive rating: pulse−width limited by maximum junction temperature.
2. L = 0.68 mH, $I_{AS}$ = 51 A, $V_{DD}$ = 50 V, $R_G$ = 25 Ω, starting $T_J$ = 25°C.
3. $I_{SD}$ ≤ 51 A, di/dt ≤ 200 A/μs, $V_{DD}$ ≤ $BV_{DSS}$, starting $T_J$ = 25°C.

**THERMAL CHARACTERISTICS**

| Symbol | Parameter | FDP51N25 | FDPF51N25 | Unit |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction−to−Case, Max. | 0.39 | 3.3 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction−to−Ambient, Max. | 62.5 | 62.5 | °C/W |

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| $BV_{DSS}$ | Drain−Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 μA, $T_J$ = 25°C | 250 | – | – | V |
| $\Delta BV_{DSS}$ / $\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | – | 0.25 | – | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 250 V, $V_{GS}$ = 0 V<br>$V_{DS}$ = 200 V, $T_C$ = 125°C | –<br>– | –<br>– | 1<br>10 | μA<br>μA |
| $I_{GSSF}$ | Gate−Body Leakage Current, Forward | $V_{GS}$ = 30 V, $V_{DS}$ = 0 V | – | – | 100 | nA |
| $I_{GSSR}$ | Gate−Body Leakage Current, Reverse | $V_{GS}$ = −30 V, $V_{DS}$ = 0V | – | – | −100 | nA |
| **ON CHARACTERISTICS** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 μA | 3.0 | – | 5.0 | V |
| $R_{DS(on)}$ | Static Drain−Source On−Resistance | $V_{GS}$ = 10 V, $I_D$ = 25.5 A | – | 0.048 | 0.060 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 40 V, $I_D$ = 25.5 A | – | 43 | – | S |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1 MHz | – | 2620 | 3410 | pF |
| $C_{oss}$ | Output Capacitance | | – | 530 | 690 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | – | 63 | 90 | pF |
| **SWITCHING CHARACTERISTICS** | | | | | | |
| $t_{d(on)}$ | Turn−On Delay Time | $V_{DD}$ = 125 V, $I_D$ = 51 A, $V_{GS}$ = 10 V, $R_G$ = 25 Ω (Note 4) | – | 62 | 135 | ns |
| $t_r$ | Turn−On Rise Time | | – | 465 | 940 | ns |
| $t_{d(off)}$ | Turn−Off Delay Time | | – | 98 | 205 | ns |
| $t_f$ | Turn−Off Fall Time | | – | 130 | 270 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 200 V, $I_D$ = 51 A, $V_{GS}$ = 10 V (Note 4) | – | 55 | 70 | nC |
| $Q_{gs}$ | Gate−Source Charge | | – | 16 | – | nC |
| $Q_{gd}$ | Gate−Drain Charge | | – | 27 | – | nC |
| **DRAIN−SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS** | | | | | | |
| $I_S$ | Maximum Continuous Drain−Source Diode Forward Current | | – | – | 51 | A |
| $I_{SM}$ | Maximum Pulsed Drain−Source Diode Forward Current | | – | – | 204 | A |
| $V_{SD}$ | Drain−Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 51 A | – | – | 1.4 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_S$ = 51 A, $dI_F/dt$ =100 A/μs | – | 178 | – | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | – | 4.0 | – | μC |

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.

4. Essentially independent of operating temperature typical characteristics.

## TYPICAL PERFORMANCE CHARACTERISTICS

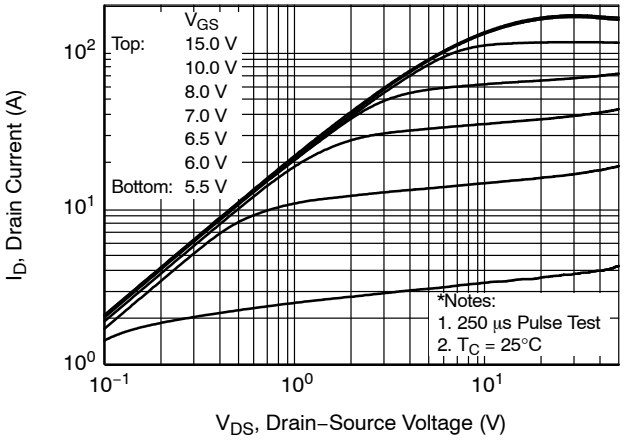



**Figure 1. On−Region Characteristics**

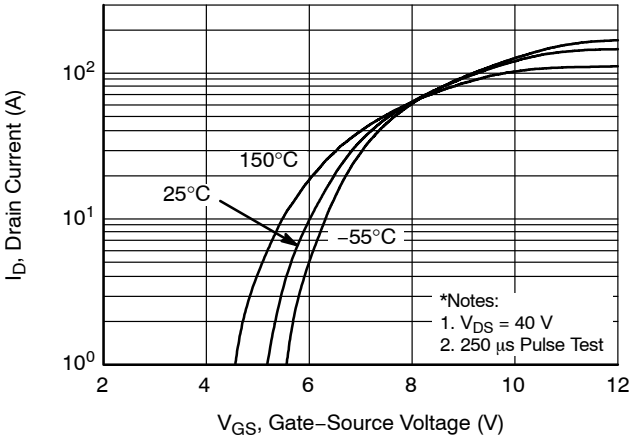



**Figure 2. Transfer Characteristics**

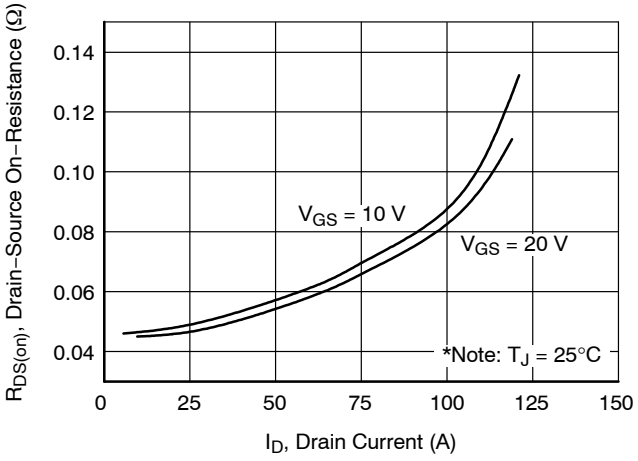



**Figure 3. On−Resistance Variation vs. Drain Current and Gate Voltage**

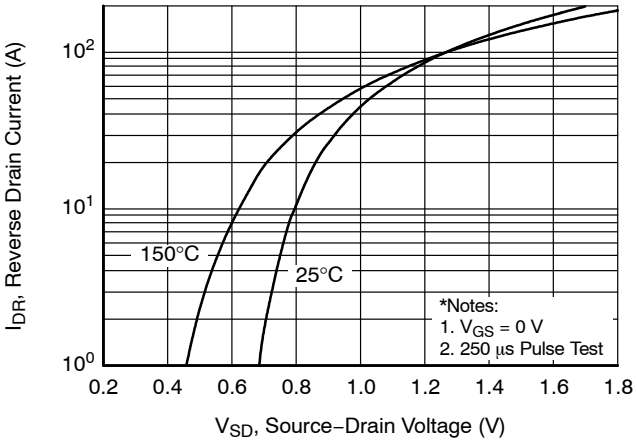



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

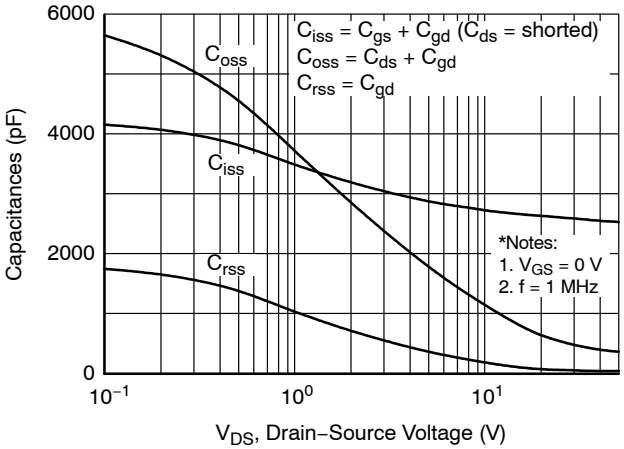



**Figure 5. Capacitance Characteristics**

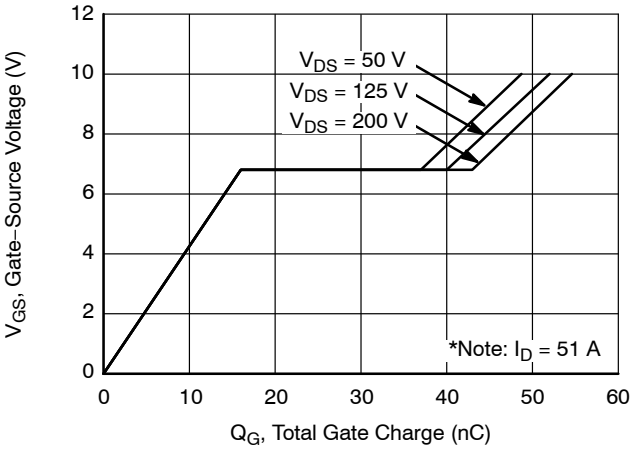



**Figure 6. Gate Charge Characteristics**

## TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

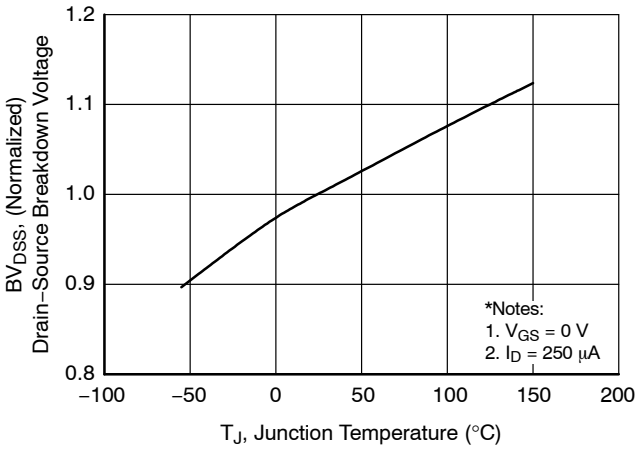



**Figure 7. Breakdown Voltage Variation vs. Temperature**

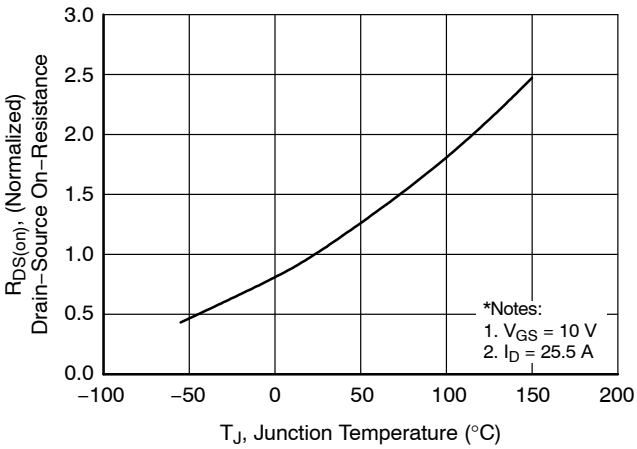



**Figure 8. On−Resistance Variation vs. Temperature**

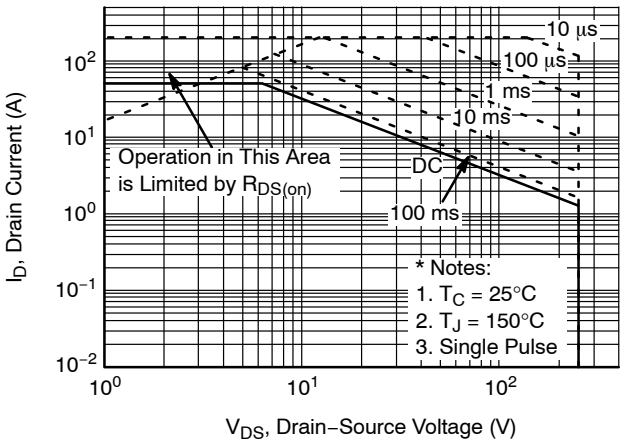



**Figure 9−1. Maximum Safe Operating Area for FDP51N25**

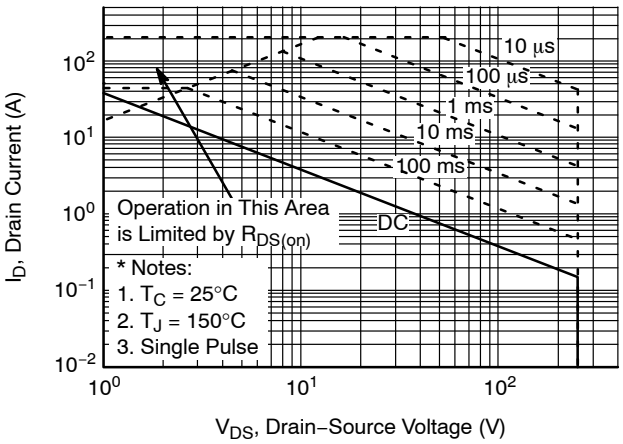



**Figure 9−2. Maximum Safe Operating Area for FDPF51N25**

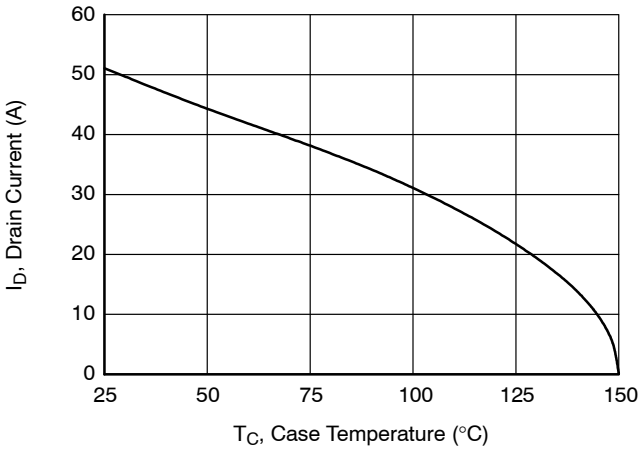



**Figure 10. Maximum Drain Current vs. Case Temperature**

## TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

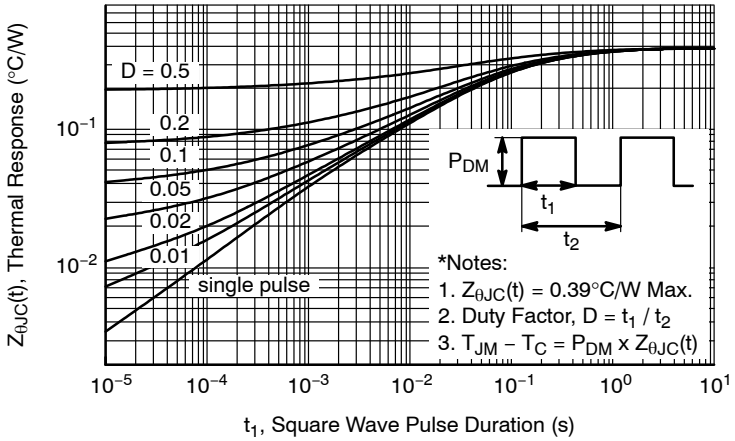



**Figure 11−1. Transient Thermal Response Curve for FDP51N25**

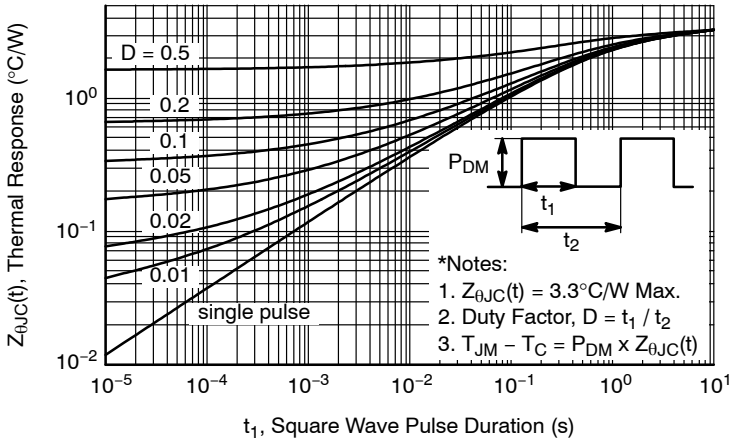



**Figure 11−2. Transient Thermal Response Curve for FDPF51N25**

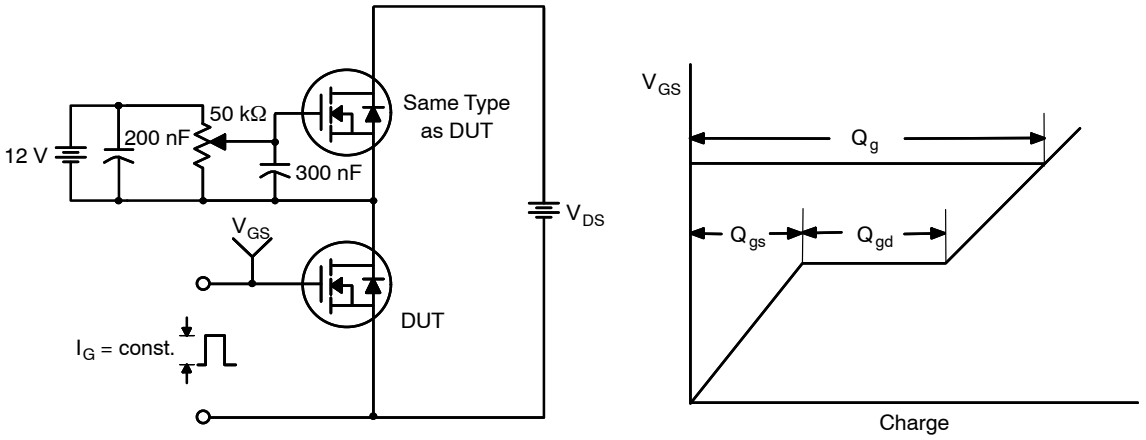



**Figure 11. Gate Charge Test Circuit & Waveform**

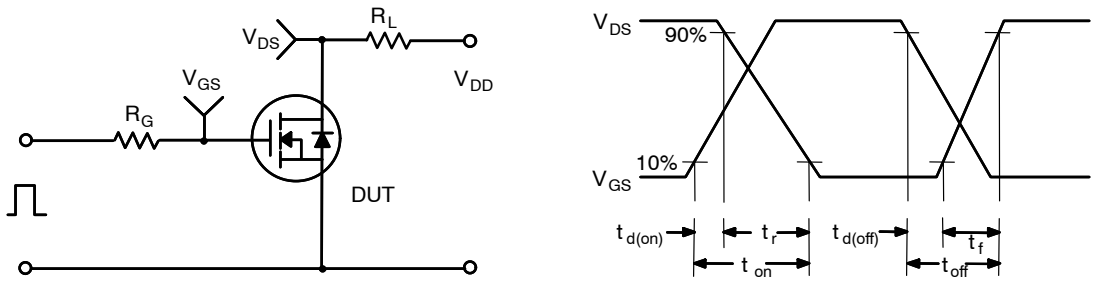



**Figure 12. Resistive Switching Test Circuit & Waveforms**

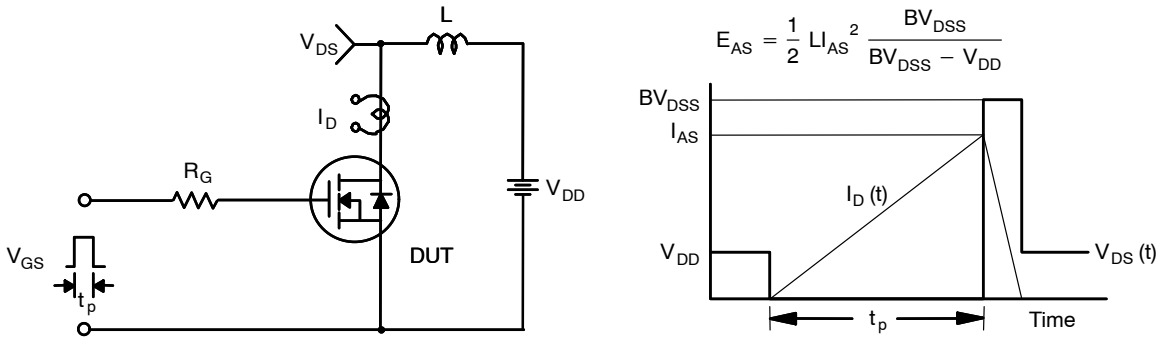
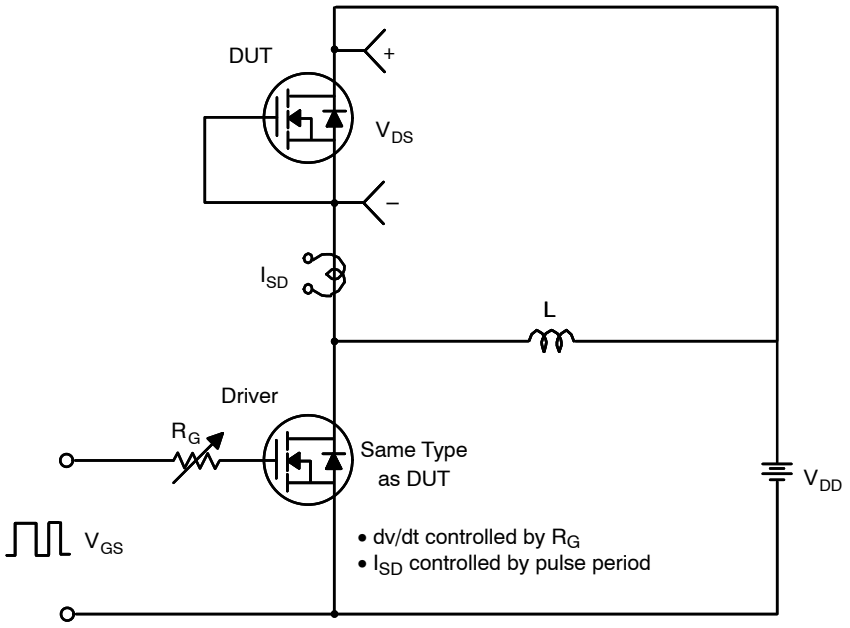
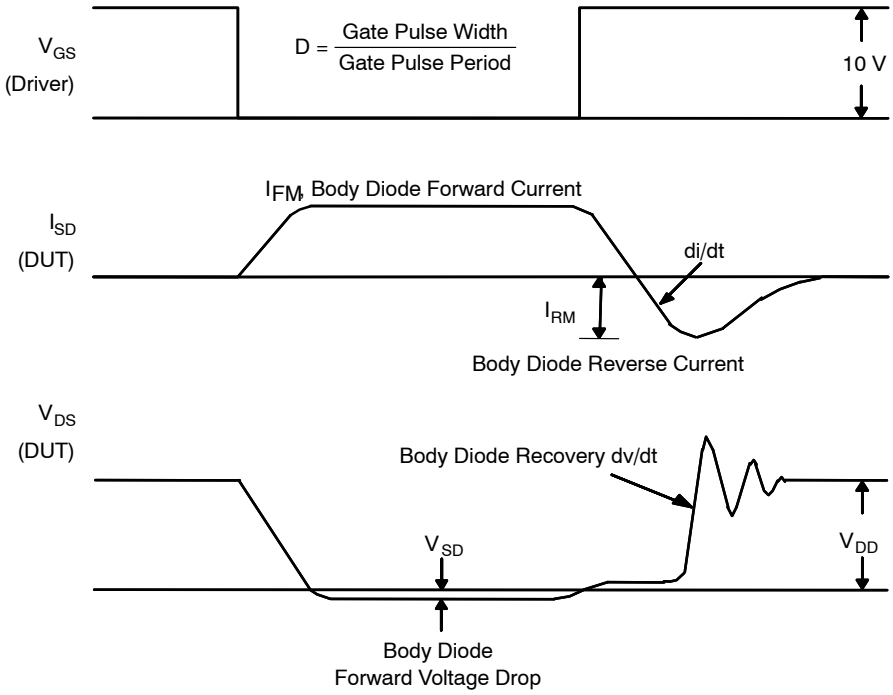



**Figure 13. Unclamped Inductive Switching Test Circuit & Waveforms**



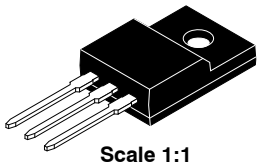



## PACKAGE MARKING AND ORDERING INFORMATION

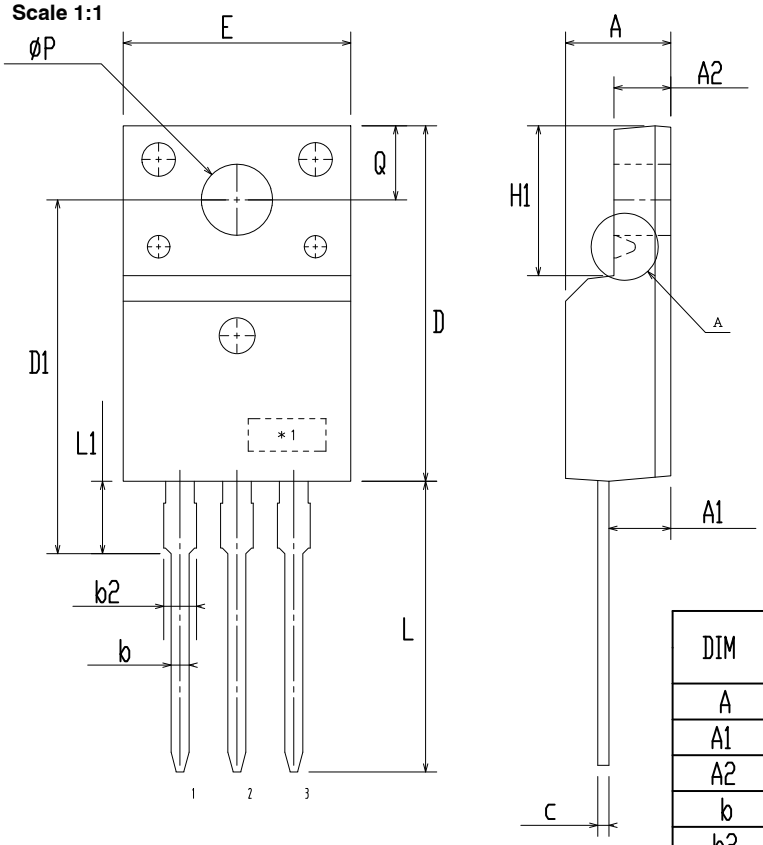
| Part Number | Top Mark | Package | Shipping |
|---|---|---|---|
| FDP51N25 | FDP51N25 | TO−220−3LD<br>CASE 340AT | 1000 Units / Tube |
| FDPF51N25 | FDPF51N25 | TO−220 Fullpack, 3−Lead / TO−220F−3SG<br>CASE 221AT | 1000 Units / Tube |

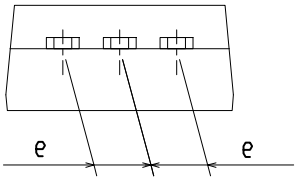
**TO−220 Fullpack, 3−Lead / TO−220F−3SG**
CASE 221AT
ISSUE B

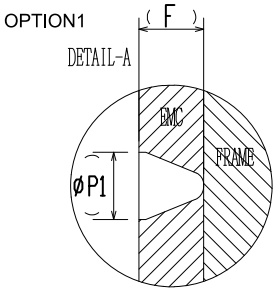
DATE 19 JAN 2021



**Scale 1:1**



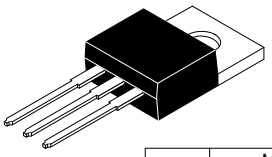




| DIM | MILLIMITERS | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 4.50 | 4.70 | 4.90 |
| A1 | 2.56 | 2.76 | 2.96 |
| A2 | 2.34 | 2.54 | 2.74 |
| b | 0.70 | 0.80 | 0.90 |
| b2 | ~ | ~ | 1.47 |
| c | 0.45 | 0.50 | 0.60 |
| D | 15.67 | 15.87 | 16.07 |
| D1 | 15.60 | 15.80 | 16.00 |
| E | 9.96 | 10.16 | 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

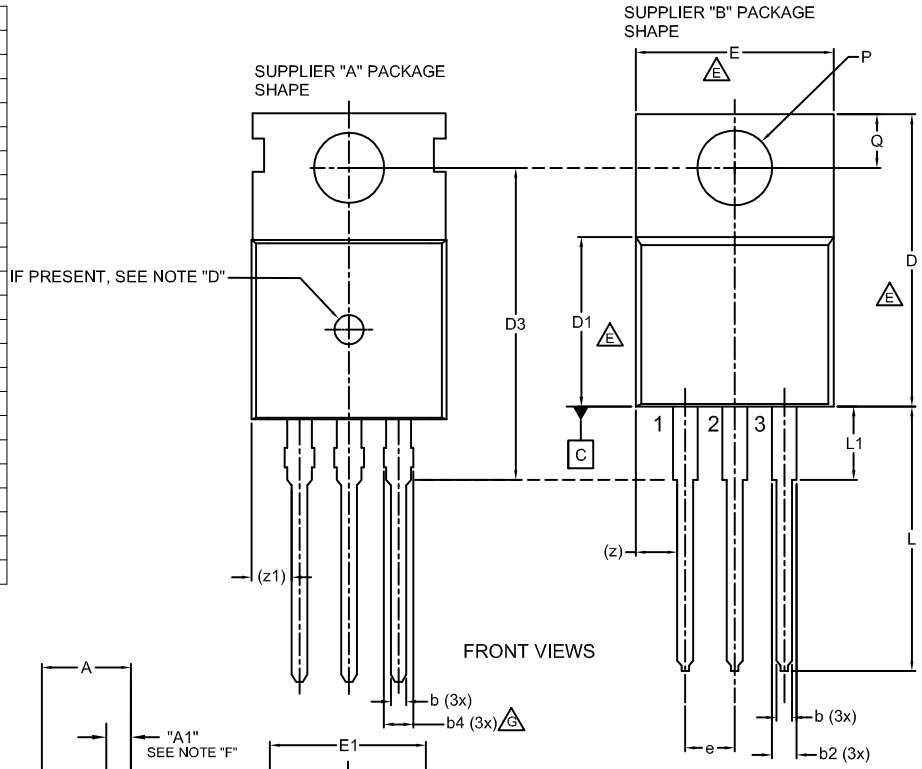
| | | |
|---|---|---|
| **DOCUMENT NUMBER:** | **98AON67439E** | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| **DESCRIPTION:** | **TO−220 FULLPACK, 3−LEAD / TO−220F−3SG**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

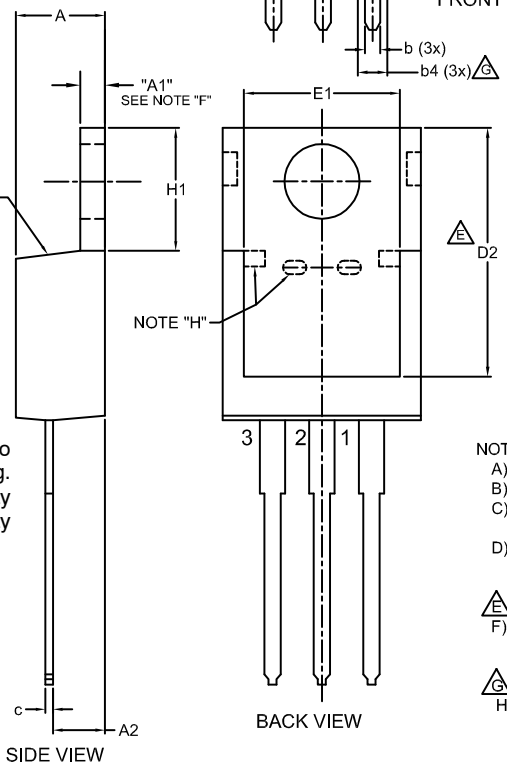


**TO−220−3LD**
CASE 340AT
ISSUE B

DATE 08 AUG 2022

| DIM | MILLIMETERS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | 4.00 | -- | 4.70 |
| A1 | SEE NOTE "F" | | |
| A2 | 2.10 | -- | 2.85 |
| b | 0.55 | -- | 1.00 |
| b2 | 1.10 | -- | 1.62 |
| b4 | 1.42 | -- | 1.62 |
| c | 0.36 | -- | 0.60 |
| D | 13.90 | -- | 16.30 |
| D1 | 8.13 | -- | 9.40 |
| D2 | 11.50 | -- | 14.30 |
| D3 | 15.42 | -- | 16.51 |
| E | 9.65 | -- | 10.67 |
| E1 | 7.59 | -- | 8.65 |
| e | 2.40 | -- | 2.67 |
| H1 | 6.06 | -- | 6.69 |
| L | 12.70 | -- | 14.04 |
| L1 | 2.70 | -- | 4.10 |
| P | 3.50 | -- | 4.00 |
| Q | 2.50 | -- | 3.40 |
| z | 2.13 REF | | |
| z1 | 2.06 REF | | |
| Θ | 3° | – | 5° |




**GENERIC MARKING DIAGRAM***


XXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
ZZ = Assembly Lot Code

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “▪”, may or may not be present. Some products may not follow the Generic Marking.

NOTES:
A) REFERENCE JEDEC, TO-220, VARIATION AB
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS COMMON TO ALL PACKAGE SUPPLIERS EXCEPT WHERE NOTED [ ].
D) LOCATION OF MOLDED FEATURE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)
E DOES NOT COMPLY JEDEC STANDARD VALUE.
F) "A1" DIMENSIONS AS BELOW:
SINGLE GAUGE = 0.51 - 0.61
DUAL GAUGE = 1.10 - 1.45
G PRESENCE IS SUPPLIER DEPENDENT
H) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.

| | | | |
|---|---|---|---|
| **DOCUMENT NUMBER:** | **98AON13818G** | 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−220−3LD** | | **PAGE 1 OF 1** |

## ADDITIONAL INFORMATION

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

**ONLINE SUPPORT**: www.onsemi.com/support
**For additional information, please contact your local Sales Representative at** www.onsemi.com/support/sales

◊