

# MOSFET – N-Channel, UniFET™

**250 V, 33 A, 94 mΩ**

**FDB33N25**

## 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.

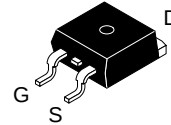
## Features

- $R_{DS(on)} = 94 \text{ m}\Omega$  (Max.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 16.5 \text{ A}$
- Low Gate Charge (Typ. 36.8 nC)
- Low  $C_{rss}$  (Typ. 39 pF)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

## Applications

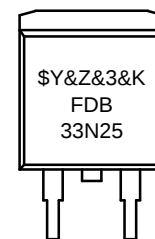
- PDP TV
- Lighting
- Uninterruptible Power Supply
- AC-DC Power Supply

| $V_{DSS}$ | $R_{DS(on)} \text{ MAX}$ | $I_D \text{ MAX}$ |
|-----------|--------------------------|-------------------|
| 250 V     | 94 mΩ @ 10 V             | 33 A              |

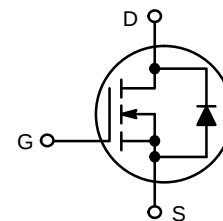


**D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)**  
**CASE 418AJ**

## MARKING DIAGRAM



|          |                                      |
|----------|--------------------------------------|
| \$Y      | = Logo                               |
| &Z       | = Assembly Plant Code                |
| &3       | = 3-Digit Date Code Format           |
| &K       | = 2-Digits Lot Run Traceability Code |
| FDB33N25 | = Device Code                        |



**N-Channel**

## ORDERING INFORMATION

See detailed ordering and shipping information on page 7 of this data sheet.

# FDB33N25

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

| Symbol         | Parameter                                                            |                                          | Value       | Unit                |
|----------------|----------------------------------------------------------------------|------------------------------------------|-------------|---------------------|
| $V_{DSS}$      | Drain-Source Voltage                                                 |                                          | 250         | V                   |
| $I_D$          | Drain Current                                                        | Continuous ( $T_C = 25^\circ\text{C}$ )  | 33          | A                   |
|                |                                                                      | Continuous ( $T_C = 100^\circ\text{C}$ ) | 20.4        |                     |
| $I_{DM}$       | Drain Current                                                        | Pulsed (Note 1)                          | 132         | A                   |
| $V_{GSS}$      | Gate-Source Voltage                                                  |                                          | $\pm 30$    | V                   |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                              |                                          | 918         | mJ                  |
| $I_{AR}$       | Avalanche Current (Note 1)                                           |                                          | 33          | A                   |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)                                 |                                          | 23.5        | mJ                  |
| dv/dt          | Peak Diode Recovery dv/dt (Note 3)                                   |                                          | 4.5         | V/ns                |
| $P_D$          | Power Dissipation                                                    | ( $T_C = 25^\circ\text{C}$ )             | 235         | W                   |
|                |                                                                      | Derate Above $25^\circ\text{C}$          | 1.89        | W/ $^\circ\text{C}$ |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range                              |                                          | -55 to +150 | $^\circ\text{C}$    |
| $T_L$          | Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds |                                          | 300         | $^\circ\text{C}$    |

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.

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $L = 1.35\text{ mH}$ ,  $I_{AS} = 33\text{ A}$ ,  $V_{DD} = 50\text{ V}$ ,  $R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 33\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .

## THERMAL CHARACTERISTICS

| Symbol          | Parameter                                                                            | Value | Unit                      |
|-----------------|--------------------------------------------------------------------------------------|-------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case, Max.                                           | 0.53  | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient (1 in <sup>2</sup> Pad of 2-oz Copper), Max. | 40    |                           |
|                 | Thermal Resistance, Junction-to-Ambient (Minimum Pad of 2-oz Copper), Max.           | 62.5  |                           |

# FDB33N25

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

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

### OFF CHARACTERISTICS

|                                      |                                           |                                                 |     |      |      |      |
|--------------------------------------|-------------------------------------------|-------------------------------------------------|-----|------|------|------|
| BV <sub>DSS</sub>                    | Drain-Source Breakdown Voltage            | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA  | 250 | –    | –    | V    |
| ΔBV <sub>DSS</sub> / ΔT <sub>J</sub> | Breakdown Voltage Temperature Coefficient | I <sub>D</sub> = 250 μA, Referenced to 25°C     | –   | 0.25 | –    | V/°C |
| I <sub>DSS</sub>                     | Zero Gate Voltage Drain Current           | V <sub>DS</sub> = 250 V, V <sub>GS</sub> = 0 V  | –   | –    | 1    | μA   |
|                                      |                                           | V <sub>DS</sub> = 200 V, T <sub>C</sub> = 125°C | –   | –    | 10   |      |
| I <sub>GSSF</sub>                    | Gate-Body Leakage Current, Forward        | V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V   | –   | –    | 100  | nA   |
| I <sub>GSSR</sub>                    | Gate-Body Leakage Current, Reverse        | V <sub>GS</sub> = –30 V, V <sub>DS</sub> = 0 V  | –   | –    | –100 | nA   |

### ON CHARACTERISTICS

|                     |                                   |                                                             |     |       |       |   |
|---------------------|-----------------------------------|-------------------------------------------------------------|-----|-------|-------|---|
| V <sub>GS(th)</sub> | Gate Threshold Voltage            | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA | 3.0 | –     | 5.0   | V |
| R <sub>DS(on)</sub> | Static Drain-Source On-Resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 16.5 A             | –   | 0.077 | 0.094 | Ω |
| g <sub>FS</sub>     | Forward Transconductance          | V <sub>DS</sub> = 40 V, I <sub>D</sub> = 16.5 A             | –   | 26.6  | –     | S |

### DYNAMIC CHARACTERISTICS

|                  |                              |                                                          |   |      |      |    |
|------------------|------------------------------|----------------------------------------------------------|---|------|------|----|
| C <sub>iss</sub> | Input Capacitance            | V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1 MHz | – | 1640 | 2135 | pF |
| C <sub>oss</sub> | Output Capacitance           |                                                          | – | 330  | 430  | pF |
| C <sub>rss</sub> | Reverse Transfer Capacitance |                                                          | – | 39   | 59   | pF |

### SWITCHING CHARACTERISTICS

|                     |                     |                                                                                                        |   |      |     |    |
|---------------------|---------------------|--------------------------------------------------------------------------------------------------------|---|------|-----|----|
| t <sub>d(on)</sub>  | Turn-On Delay Time  | V <sub>DD</sub> = 125 V, I <sub>D</sub> = 33 A, V <sub>GS</sub> = 10 V, R <sub>G</sub> = 25 Ω (Note 4) | – | 35   | 80  | ns |
| t <sub>r</sub>      | Turn-On Rise Time   |                                                                                                        | – | 230  | 470 | ns |
| t <sub>d(off)</sub> | Turn-Off Delay Time |                                                                                                        | – | 75   | 160 | ns |
| t <sub>f</sub>      | Turn-Off Fall Time  |                                                                                                        | – | 120  | 250 | ns |
| Q <sub>g</sub>      | Total Gate Charge   | V <sub>DS</sub> = 200 V, I <sub>D</sub> = 33 A, V <sub>GS</sub> = 10 V (Note 4)                        | – | 36.8 | 48  | nC |
| Q <sub>gs</sub>     | Gate-Source Charge  |                                                                                                        | – | 10   | –   | nC |
| Q <sub>gd</sub>     | Gate-Drain Charge   |                                                                                                        | – | 17   | –   | nC |

### DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

|                 |                                                       |                                                                              |   |      |     |    |
|-----------------|-------------------------------------------------------|------------------------------------------------------------------------------|---|------|-----|----|
| I <sub>S</sub>  | Maximum Continuous Drain–Source Diode Forward Current |                                                                              | – | –    | 33  | A  |
| I <sub>SM</sub> | Maximum Pulsed Drain–Source Diode Forward Current     |                                                                              | – | –    | 132 | A  |
| V <sub>SD</sub> | Drain–Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 33 A                                 | – | –    | 1.4 | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                 | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 33 A, dI <sub>F</sub> /dt = 100 A/μs | – | 220  | –   | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                               |                                                                              | – | 1.71 | –   | 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

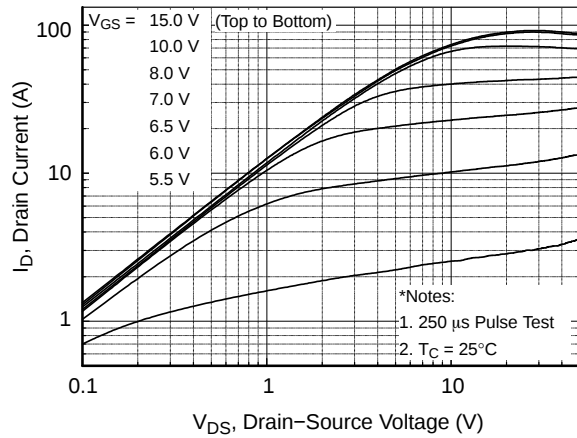


Figure 1. On-Region Characteristics

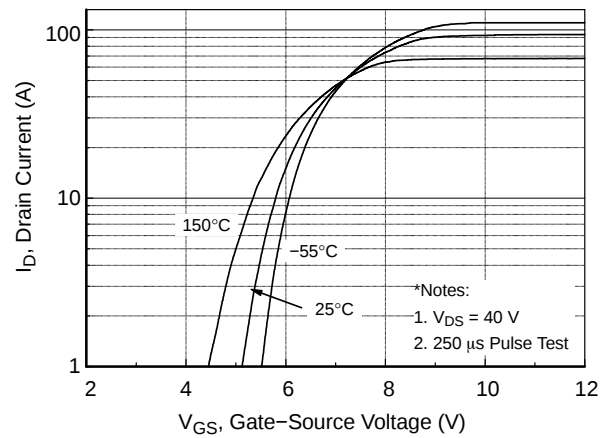


Figure 2. Transfer Characteristics

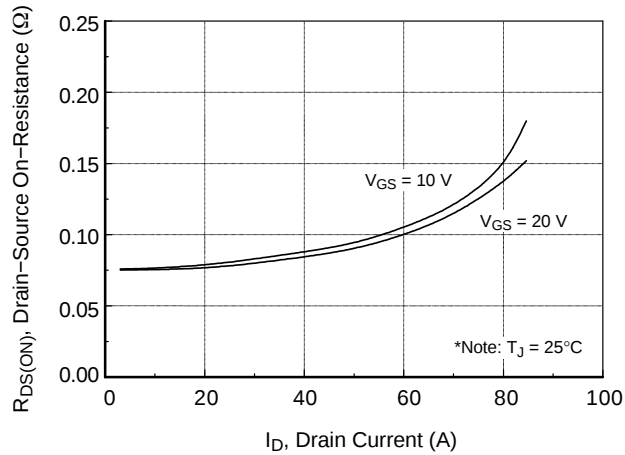


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

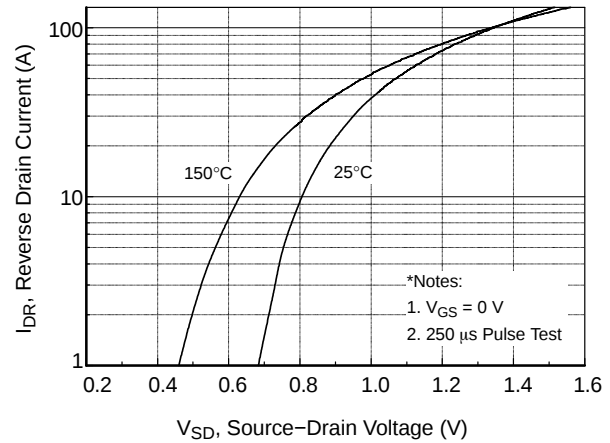


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

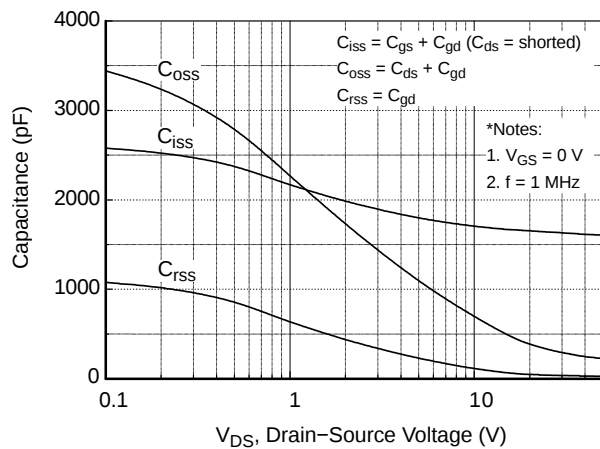


Figure 5. Capacitance Characteristics

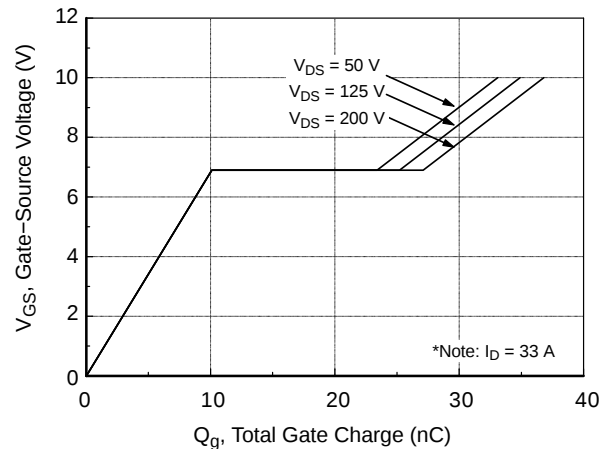


Figure 6. Gate Charge Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

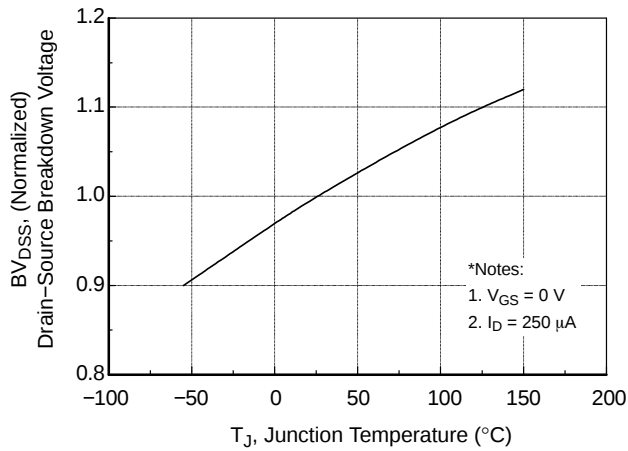


Figure 7. Breakdown Voltage Variation vs. Temperature

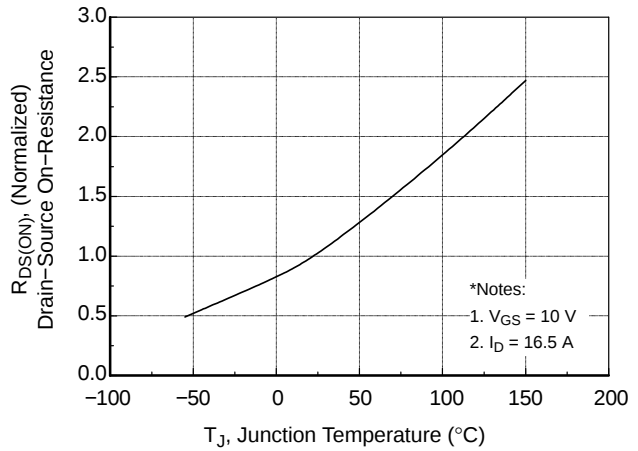


Figure 8. On-Resistance Variation vs. Temperature

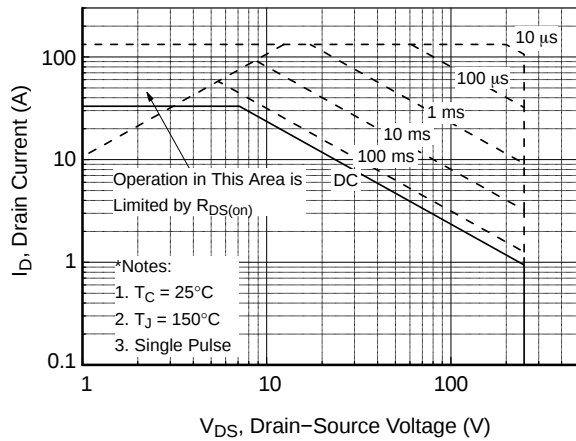


Figure 9. Maximum Safe Operating Area

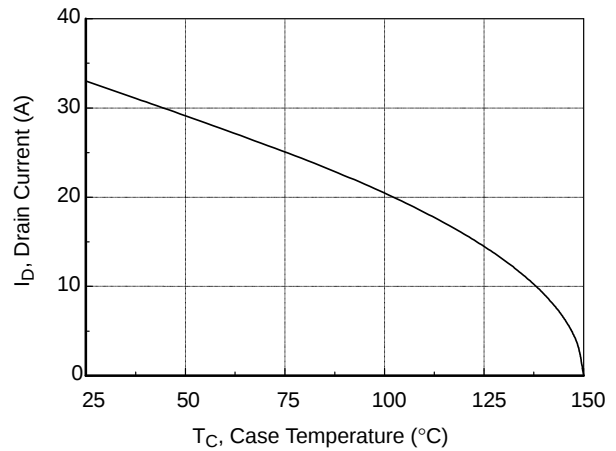


Figure 10. Maximum Drain Current vs. Case Temperature

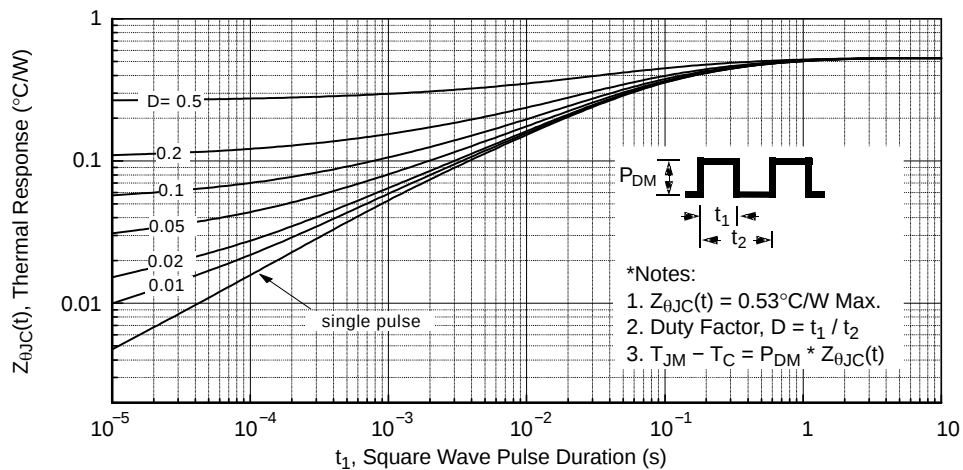
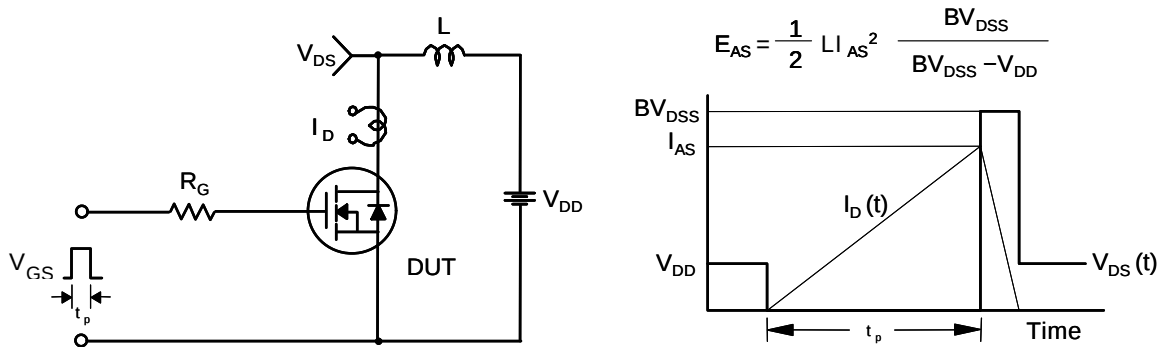
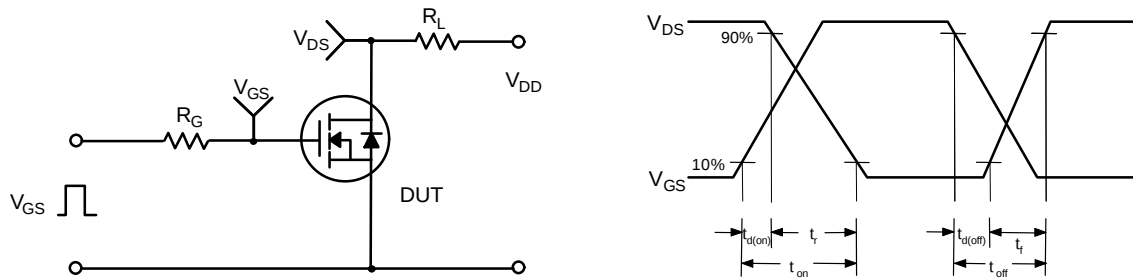
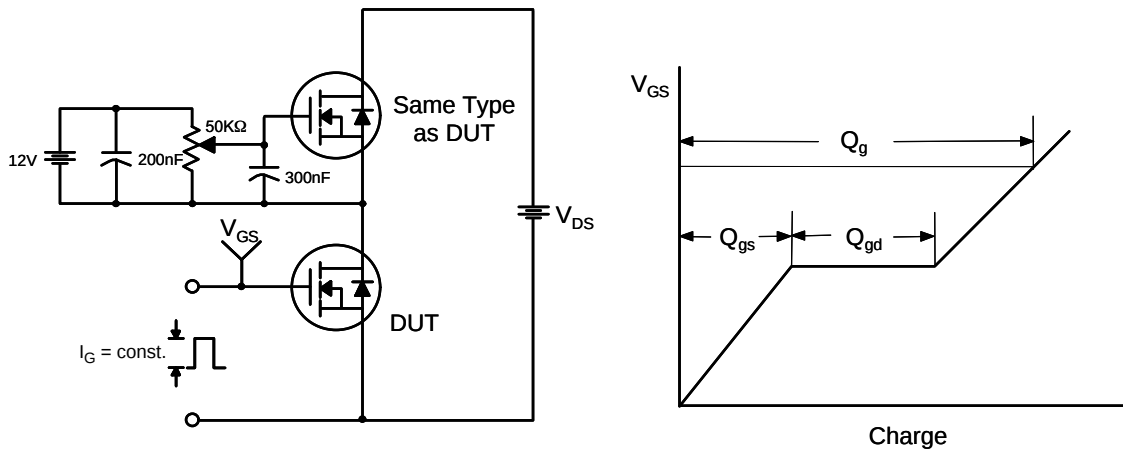


Figure 11. Transient Thermal Response Curve



## FDB33N25

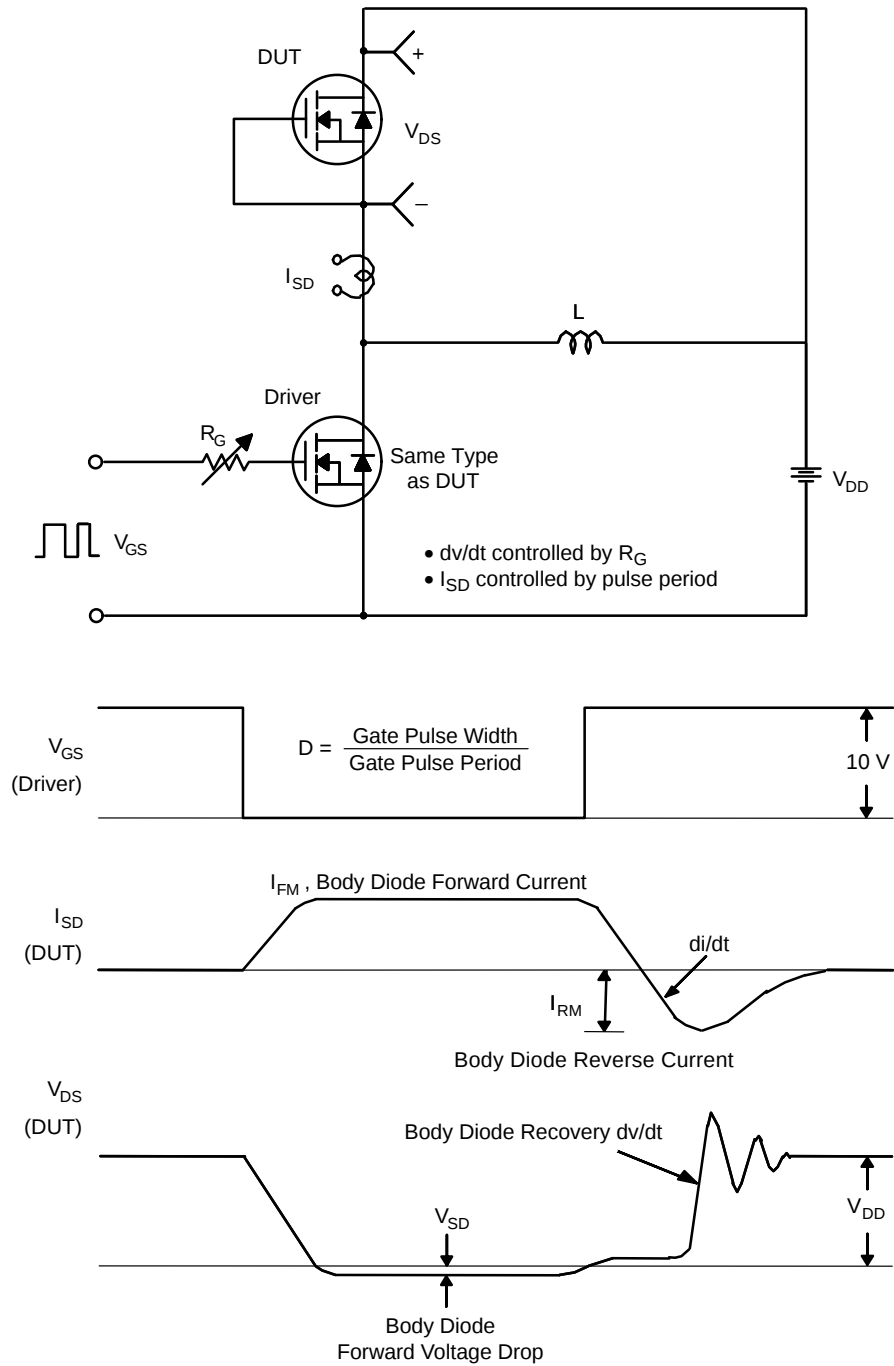


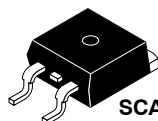
Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

### PACKAGE MARKING AND ORDERING INFORMATION

| Part Number | Top Mark | Package             | Shipping <sup>†</sup> |
|-------------|----------|---------------------|-----------------------|
| FDB33N25TM  | FDB33N25 | D <sup>2</sup> -PAK | 800 / Tape & Reel     |

<sup>†</sup>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.

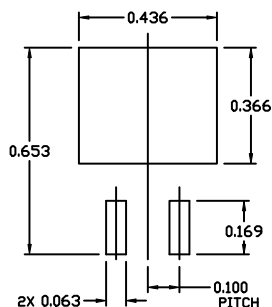
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SCALE 1:1

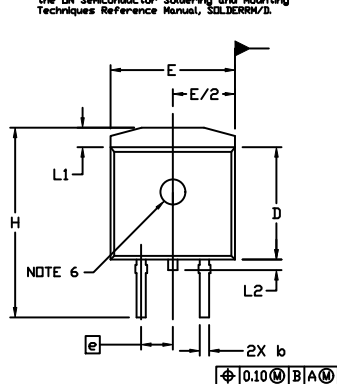
**D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)**  
CASE 418AJ  
ISSUE F

DATE 11 MAR 2021



**RECOMMENDED  
MOUNTING FOOTPRINT**

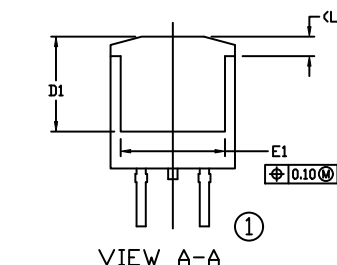
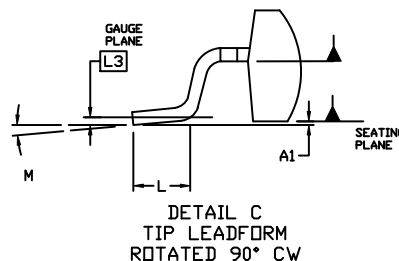
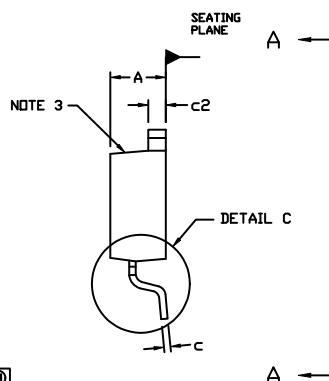
For additional information on our Pb-free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



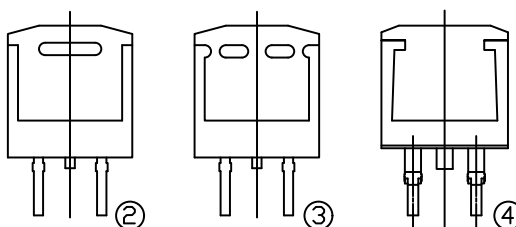
**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: INCHES
3. CHAMFER OPTIONAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
5. THERMAL PAD CONTOUR IS OPTIONAL WITHIN DIMENSIONS E, L1, D1, AND E1.
6. OPTIONAL MOLD FEATURE.
7. ①, ② ... OPTIONAL CONSTRUCTION FEATURE CALL OUTS.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN.      | MAX.  | MIN.        | MAX.  |
| A   | 0.160     | 0.190 | 4.06        | 4.83  |
| A1  | 0.000     | 0.010 | 0.00        | 0.25  |
| b   | 0.020     | 0.039 | 0.51        | 0.99  |
| c   | 0.012     | 0.029 | 0.30        | 0.74  |
| c2  | 0.045     | 0.065 | 1.14        | 1.65  |
| D   | 0.330     | 0.380 | 8.38        | 9.65  |
| D1  | 0.260     | ---   | 6.60        | ---   |
| E   | 0.380     | 0.420 | 9.65        | 10.67 |
| E1  | 0.245     | ---   | 6.22        | ---   |
| e   | 0.100 BSC | ---   | 2.54 BSC    | ---   |
| H   | 0.575     | 0.625 | 14.60       | 15.88 |
| L   | 0.070     | 0.110 | 1.78        | 2.79  |
| L1  | ---       | 0.066 | ---         | 1.68  |
| L2  | ---       | 0.070 | ---         | 1.78  |
| L3  | 0.010 BSC | ---   | 0.25 BSC    | ---   |
| M   | 0°        | 8°    | 0°          | 8°    |

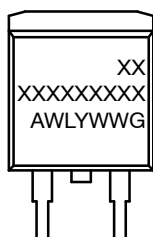


VIEW A-A

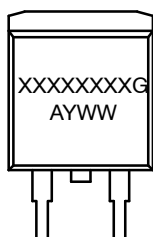


VIEW A-A  
OPTIONAL CONSTRUCTIONS

**GENERIC MARKING DIAGRAMS\***



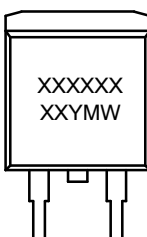
IC



Standard



Rectifier



SSG

XXXXXX = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
Y = Year  
WW = Work Week  
W = Week Code (SSG)  
M = Month Code (SSG)  
G = Pb-Free Package  
AKA = Polarity Indicator

\*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.

|                         |                                            |                                                                                                                                                                                  |
|-------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

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onsemi Website: [www.onsemi.com](http://www.onsemi.com)

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