FAIRCHILD SEMICONDUCTOR®

November 2013

# FDH45N50F

## N-Channel UniFET™ FRFET® MOSFET

**500 V, 45 A, 120 mΩ**

### Features

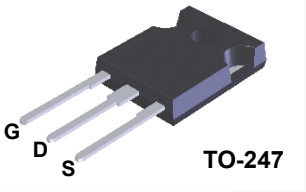
- $R_{DS(on)}$ = 105 mΩ (Typ.) @ $V_{GS}$ = 10 V, $I_D$ = 22.5 A
- Low Gate Charge (Typ. 105 nC)
- Low $C_{rss}$ (Typ. 62 pF)
- 100% Avalanche Tested
- Improved dv/dt Capability

### Applications

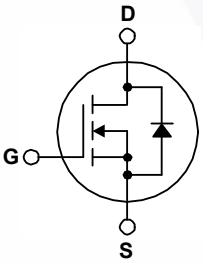
- Lighting
- Uninterruptible Power Supply
- AC-DC Power Supply

### Description

UniFET™ MOSFET is Fairchild Semiconductor'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. The body diode's reverse recovery performance of UniFET FRFET® MOSFET has been enhanced by lifetime control. Its $t_{rr}$ is less than 100nsec and the reverse dv/dt immunity is 15V/ns while normal planar MOSFETs have over 200nsec and 4.5V/nsec respectively. Therefore, it can remove additional component and improve system reliability in certain applications in which the performance of MOSFET's body diode is significant. 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




TO-247




### Absolute Maximum Ratings

$T_C$ = 25°C unless otherwise noted.

| Symbol | Parameter | | FDH45N50F_F133 | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | 500 | V |
| $I_D$ | Drain Current | - Continuous ($T_C$ = 25°C)<br>- Continuous ($T_C$ = 100°C) | 45<br>28.4 | A<br>A |
| $I_{DM}$ | Drain Current | - Pulsed (Note 1) | 180 | A |
| $V_{GSS}$ | Gate-Source voltage | | ±30 | V |
| $E_{AS}$ | Single Pulsed Avalanche Energy (Note 2) | | 1868 | mJ |
| $I_{AR}$ | Avalanche Current (Note 1) | | 45 | A |
| $E_{AR}$ | Repetitive Avalanche Energy (Note 1) | | 62.5 | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | | 50 | V/ns |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C)<br>- Derate Above 25°C | 625<br>5 | 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 |

### Thermal Characteristics

| Symbol | Parameter | FDH45N50F_F133 | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case, Max. | 0.2 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient, Max. | 40 | |

## Package Marking and Ordering Information

| Part Number | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|---|
| FDH45N50F_F133 | FDH45N50F | TO-247 | Tube | N/A | N/A | 30 units |

## 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 | 500 | -- | -- | V |
| $\Delta BV_{DSS}$ / $\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | -- | 0.5 | -- | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 500 V, $V_{GS}$ = 0 V<br>$V_{DS}$ = 400 V, $T_C$ = 125°C | --<br>-- | --<br>-- | 25<br>250 | 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, $V_{DS}$ = 0 V | -- | -- | -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, $I_D$ = 22.5 A | -- | 0.105 | 0.12 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 40 V, $I_D$ = 22.5 A | -- | 49.0 | -- | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1 MHz | -- | 5100 | 6630 | pF |
| $C_{oss}$ | Output Capacitance | | -- | 790 | 1030 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | -- | 62 | -- | pF |
| $C_{oss}$ | Output Capacitance | $V_{DS}$ = 400 V, $V_{GS}$ = 0 V, f = 1 MHz | -- | 161 | -- | pF |
| $C_{oss(eff.)}$ | Effective Output Capacitance | $V_{DS}$ = 0 V to 400 V, $V_{GS}$ = 0 V | -- | 342 | -- | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 250 V, $I_D$ = 48 A, $V_{GS}$ = 10 V, $R_G$ = 25 Ω | -- | 140 | 290 | ns |
| $t_r$ | Turn-On Rise Time | | -- | 500 | 1010 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 215 | 440 | ns |
| $t_f$ | Turn-Off Fall Time | (Note 4) | -- | 245 | 500 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 400 V, $I_D$ = 48 A, $V_{GS}$ = 10 V | -- | 105 | 137 | nC |
| $Q_{gs}$ | Gate-Source Charge | | -- | 33 | -- | nC |
| $Q_{gd}$ | Gate-Drain Charge | (Note 4) | -- | 45 | -- | nC |
| **Drain-Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain-Source Diode Forward Current | | -- | -- | 45 | A |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current | | -- | -- | 180 | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 45 A | -- | -- | 1.4 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_S$ = 45 A, $dI_F/dt$ =100 A/μs | -- | 188 | -- | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | -- | 0.64 | -- | μC |

**Notes:**

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. L = 1.46 mH, $I_{AS}$ = 48 A, $V_{DD}$ = 50 V, $R_G$ = 25 Ω, starting $T_J$ = 25°C.
3. $I_{SD}$ ≤ 45 A, di/dt ≤ 200 A/μs, $V_{DD}$ ≤ $BV_{DSS}$, starting $T_J$ = 25°C.
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

**Figure 1. On-Region Characteristics**

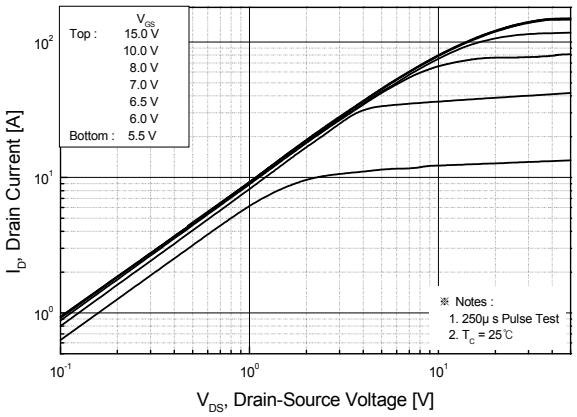



**Figure 2. Transfer Characteristics**

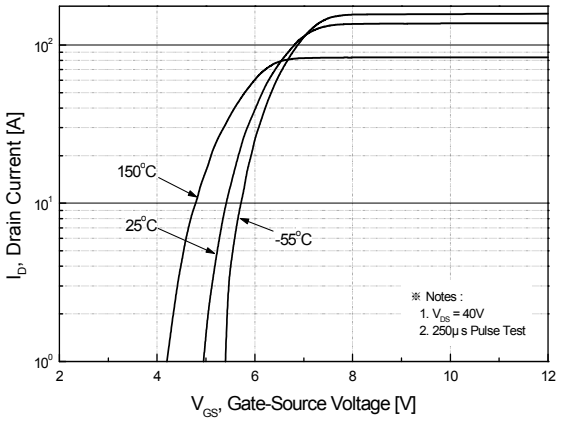



**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**

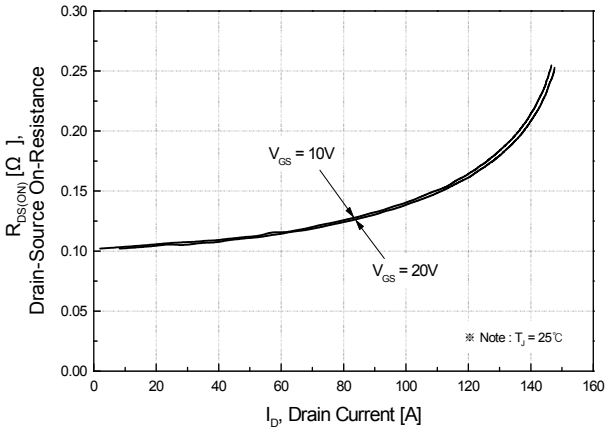



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperatue**

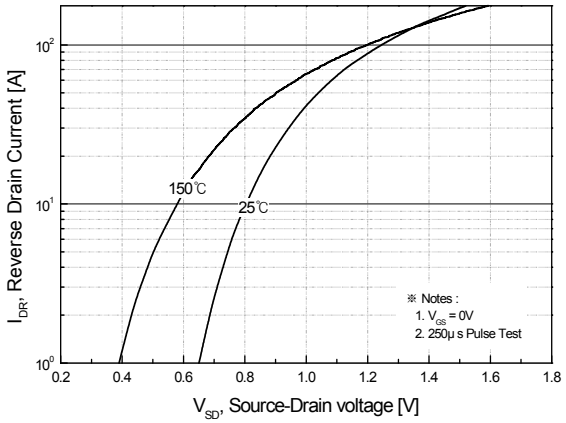



**Figure 5. Capacitance Characteristics**

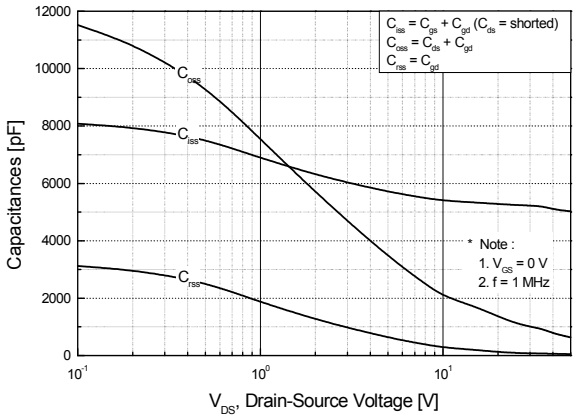
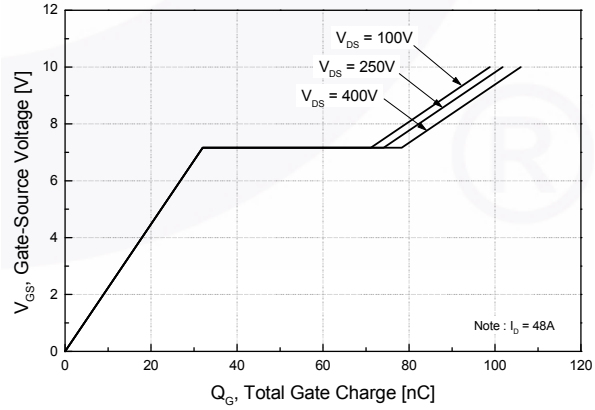



**Figure 6. Gate Charge Characteristics**



## Typical Performance Characteristics (Continued)

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

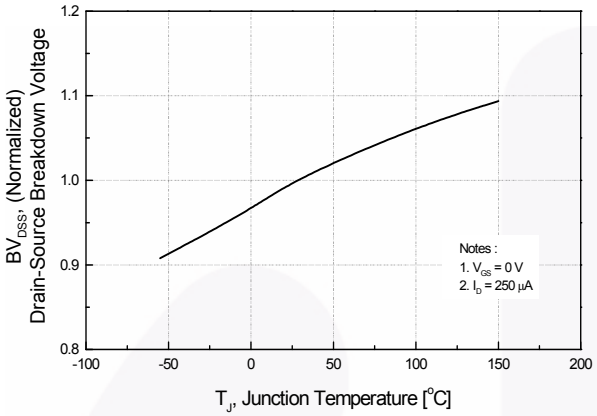



**Figure 8. On-Resistance Variation vs. Temperature**

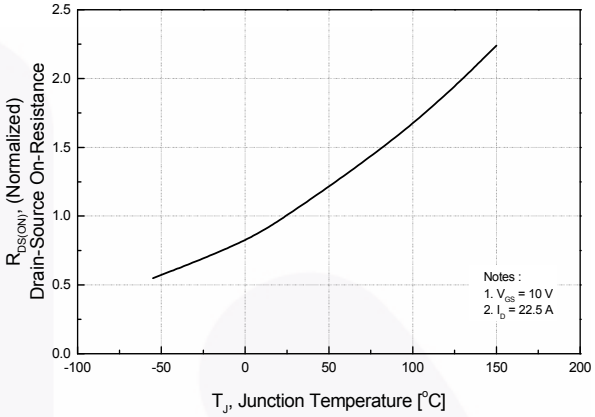



**Figure 9. Maximum Safe Operating Area**

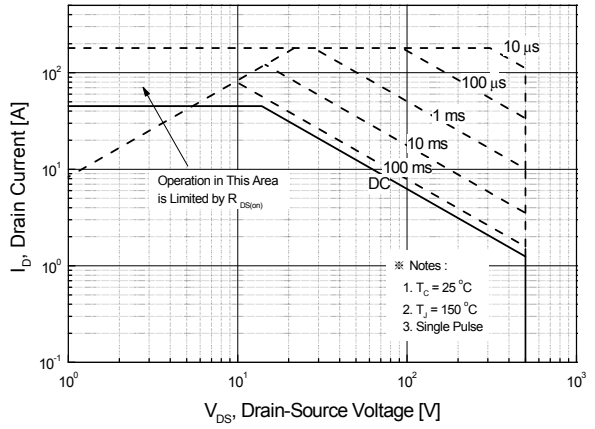



**Figure 10. Maximum Drain Current vs. Case Temperature**

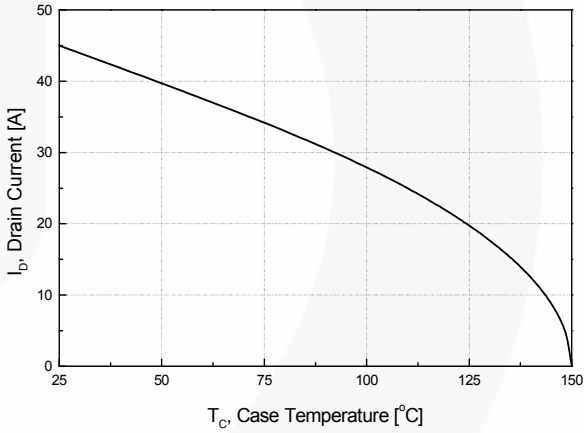



**Figure 11. Typical Drain Current Slope vs. Gate Resistance**

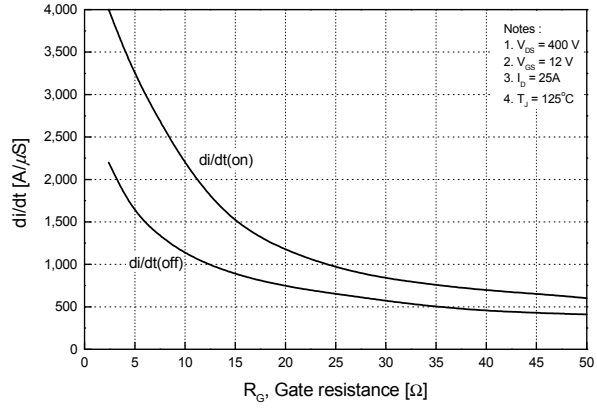
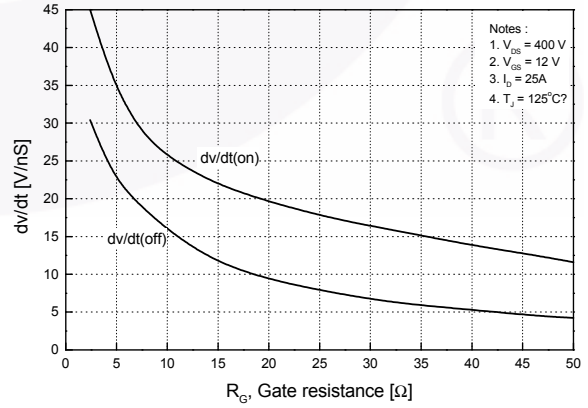



**Figure 12. Typical Drain-Source Voltage Slope vs. Gate Resistance**



## Typical Performance Characteristics (Continued)

**Figure 13. Typical Switching Losses vs. Gate Resistance**

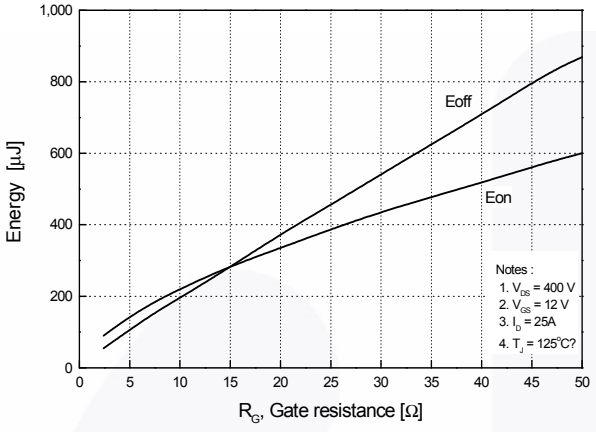



**Figure 14. Unclamped Inductive Switching Capability**

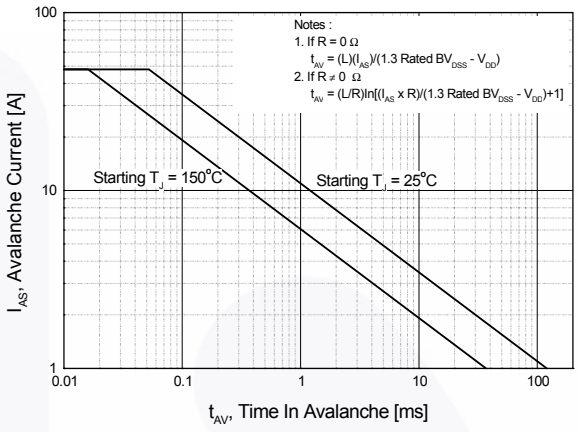
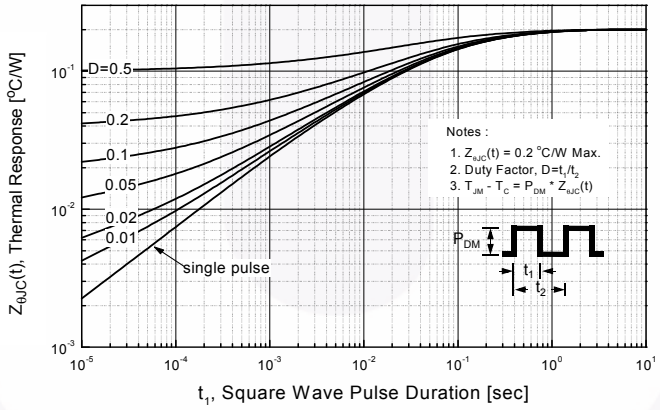



**Figure 15. Transient Thermal Resistance Curve**



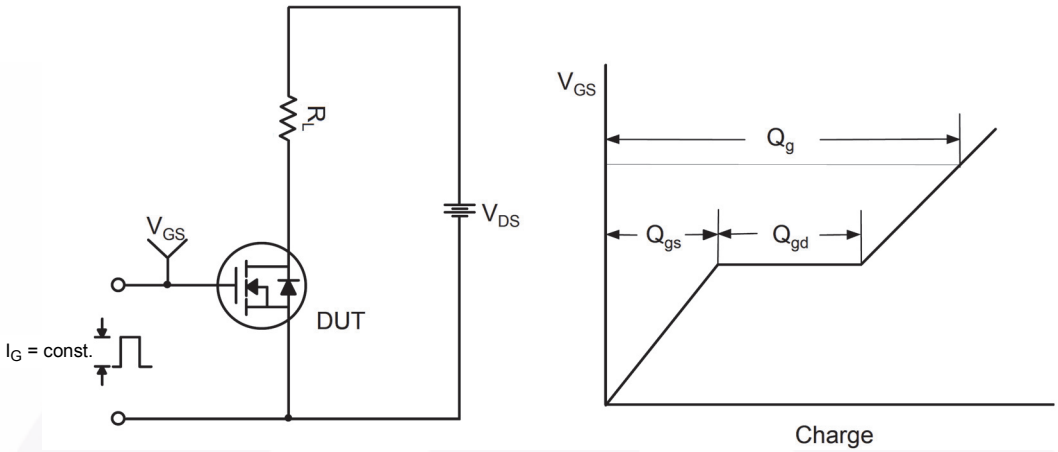



**Figure 16. Gate Charge Test Circuit & Waveform**

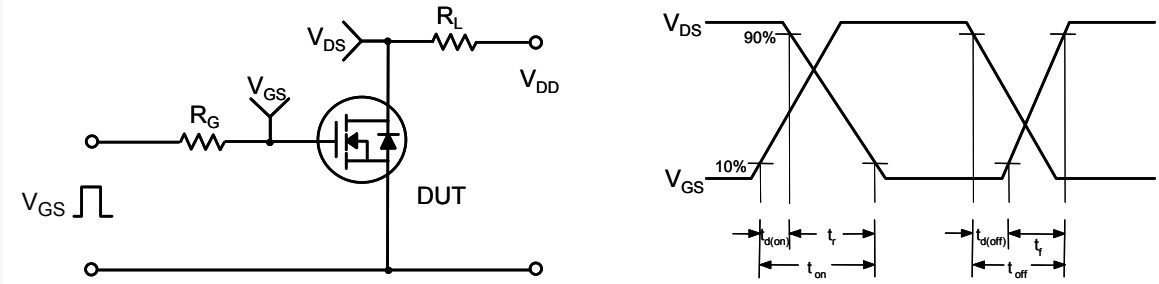



**Figure 17. Resistive Switching Test Circuit & Waveforms**

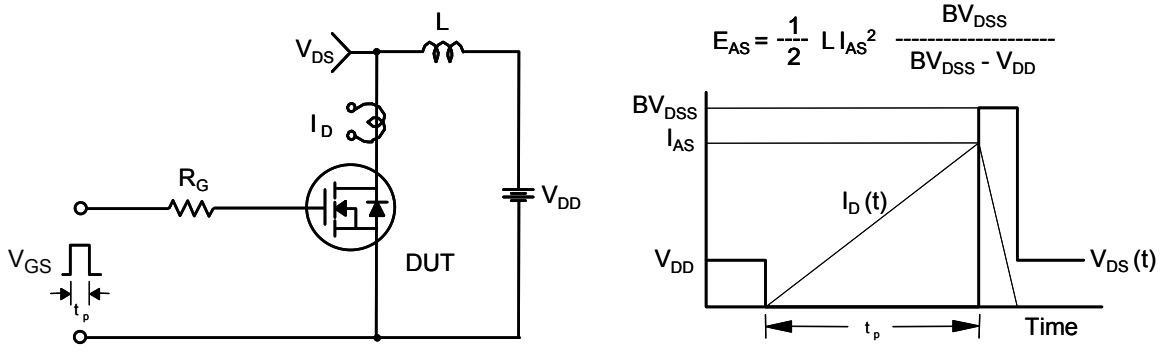



**Figure 18. Unclamped Inductive Switching Test Circuit & Waveforms**

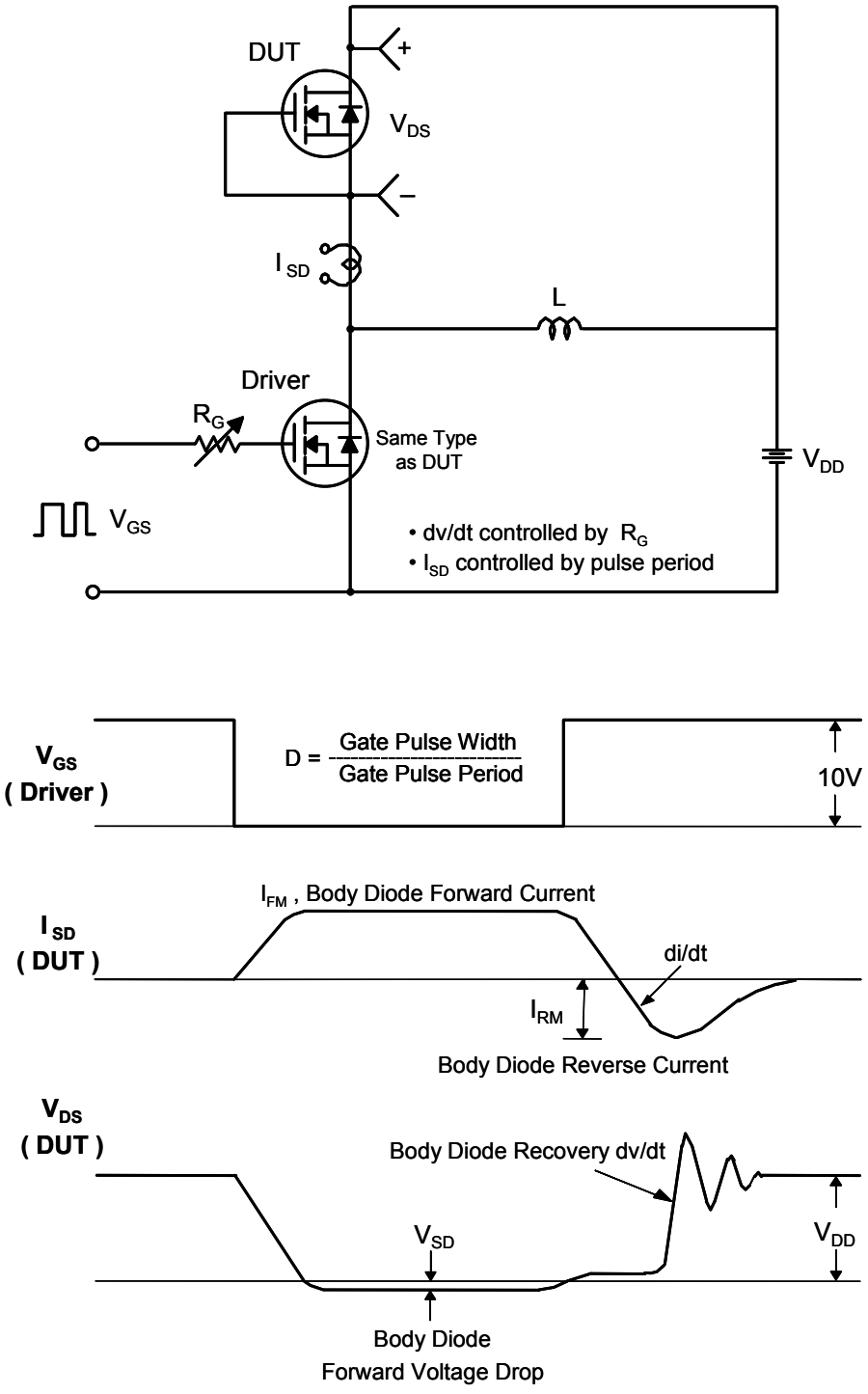
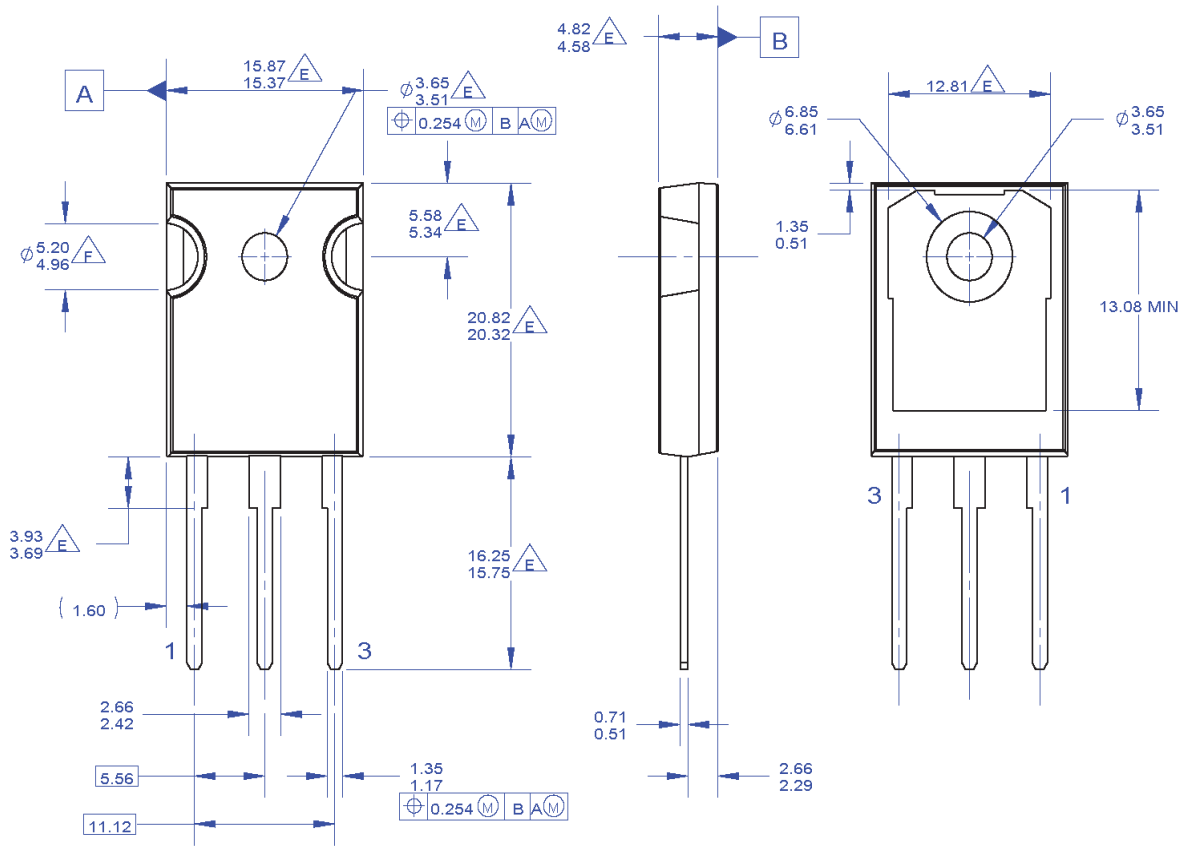



**Figure 19. Peak Diode Recovery dv/dt Test Circuit & Waveforms**

## Mechanical Dimensions

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F NOTCH MAY BE SQUARE
G. DRAWING FILENAME: MKT-TO247A03_REV03

**Figure 20. TO-247, Molded, 3-Lead, Jedec Variation AB**

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