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ON Semiconductor®

FDB12N50F

N-Channel UniFET™ FRFET® MOSFET

500 V, 11.5 A, 700 mΩ

Features

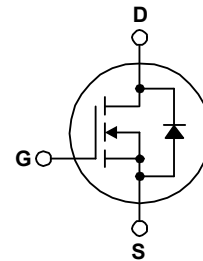
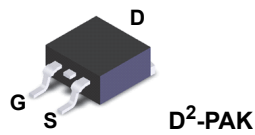
- $R_{DS(on)} = 590\text{ m}\Omega$ (Typ.) @ $V_{GS} = 10\text{ V}$, $I_D = 6\text{ A}$
- Low Gate Charge (Typ. 21 nC)
- Low C_{rss} (Typ. 11 pF)
- 100% Avalanche Tested
- Improve dv/dt Capability
- RoHS Compliant

Applications

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

Description

UniFET™ MOSFET is ON 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.



MOSFET Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted.

| Symbol | Parameter | FDB12N50FTM-WS | Unit |
|----------------|--|--|------------------|
| V_{DSS} | Drain to Source Voltage | 500 | V |
| V_{GSS} | Gate to Source Voltage | ± 30 | V |
| I_D | Drain Current | - Continuous ($T_C = 25^\circ\text{C}$) | 11.5 |
| | | - Continuous ($T_C = 100^\circ\text{C}$) | 6.9 |
| I_{DM} | Drain Current | - Pulsed (Note 1) | 46 |
| E_{AS} | Single Pulsed Avalanche Energy | (Note 2) | 456 |
| I_{AR} | Avalanche Current | (Note 1) | 11.5 |
| E_{AR} | Repetitive Avalanche Energy | (Note 1) | 16.5 |
| dv/dt | Peak Diode Recovery dv/dt | (Note 3) | 20 |
| P_D | Power Dissipation | ($T_C = 25^\circ\text{C}$) | 165 |
| | | - Derate above 25°C | 1.33 |
| T_J, T_{STG} | Operating and Storage Temperature Range | -55 to +150 | $^\circ\text{C}$ |
| T_L | Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds | 300 | $^\circ\text{C}$ |

Thermal Characteristics

| Symbol | Parameter | FQB12N50FTM_WS | Unit |
|-----------------|--|----------------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max | 0.75 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (minimum pad of 2 oz copper), Max. | 62.5 | |
| | Thermal Resistance, Junction to Ambient (1 in ² pad of 2 oz copper), Max. | 40 | |

FDB12N50F — N-Channel UniFET™ FRFET® MOSFET

Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|----------------|----------------|---------|-----------|------------|-----------|
| FDB12N50F | FDB12N50FTM_WS | D2-PAK | 330mm | 24mm | 800 units |

Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted.

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

Off Characteristics

| | | | | | | |
|--------------------------------------|---|--|-----|-----|-----------|---------------------------|
| BV_{DSS} | Drain to Source Breakdown Voltage | $I_D = 250\mu\text{A}, V_{GS} = 0\text{V}, T_J = 25^\circ\text{C}$ | 500 | - | - | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\mu\text{A}$, Referenced to 25°C | - | 0.5 | - | $\text{V}/^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 50\text{V}, V_{GS} = 0\text{V}$ | - | - | 10 | μA |
| | | $V_{DS} = 40\text{V}, T_C = 125^\circ\text{C}$ | - | - | 100 | |
| I_{GSS} | Gate to Body Leakage Current | $V_{GS} = \pm 30\text{V}, V_{DS} = 0\text{V}$ | - | - | ± 100 | nA |

On Characteristics

| | | | | | | |
|--------------|--------------------------------------|---|-----|------|-----|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS} = V_{DS}, I_D = 250\mu\text{A}$ | 3.0 | - | 5.0 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{V}, I_D = 6\text{A}$ | - | 0.59 | 0.7 | Ω |
| g_{FS} | Forward Transconductance | $V_{DS} = 40\text{V}, I_D = 6\text{A}$ | - | 12 | - | S |

Dynamic Characteristics

| | | | | | | |
|--------------|-------------------------------|--|----------|------|------|----|
| C_{iss} | Input Capacitance | $V_{DS} = 25\text{V}, V_{GS} = 0\text{V}$ $f = 1\text{MHz}$ | - | 1050 | 1395 | pF |
| C_{oss} | Output Capacitance | | - | 135 | 180 | pF |
| C_{rss} | Reverse Transfer Capacitance | | - | 11 | 17 | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10V | $V_{DS} = 40\text{V}, I_D = 11.5\text{A}$ $V_{GS} = 10\text{V}$ | - | 21 | 30 | nC |
| Q_{gs} | Gate to Source Gate Charge | | - | 6 | - | nC |
| Q_{gd} | Gate to Drain "Miller" Charge | | (Note 4) | - | 9 | - |

Switching Characteristics

| | | | | | | |
|--------------|---------------------|--|----------|----|-----|----|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 250\text{V}, I_D = 11.5\text{A}$ $R_G = 25\Omega$ | - | 21 | 50 | ns |
| t_r | Turn-On Rise Time | | - | 45 | 100 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 50 | 110 | ns |
| t_f | Turn-Off Fall Time | | (Note 4) | - | 35 | 80 |

Drain-Source Diode Characteristics

| | | | | | | |
|----------|--|---|---|------|-----|---------------|
| I_S | Maximum Continuous Drain to Source Diode Forward Current | - | - | 11.5 | A | |
| I_{SM} | Maximum Pulsed Drain to Source Diode Forward Current | - | - | 46 | A | |
| V_{SD} | Drain to Source Diode Forward Voltage | $V_{GS} = 0\text{V}, I_{SD} = 11.5\text{A}$ | - | - | 1.5 | V |
| t_{rr} | Reverse Recovery Time | $V_{GS} = 0\text{V}, I_{SD} = 11.5\text{A}$ | - | 134 | - | ns |
| Q_{rr} | Reverse Recovery Charge | $di_F/dt = 100\text{A}/\mu\text{s}$ | - | 0.37 | - | μC |

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $L = 6.9\text{mH}, I_{AS} = 11.5\text{A}, V_{DD} = 50\text{V}, R_G = 25\Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 11.5\text{A}, di/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics

Typical Characteristics

Figure 1. On-Region Characteristics

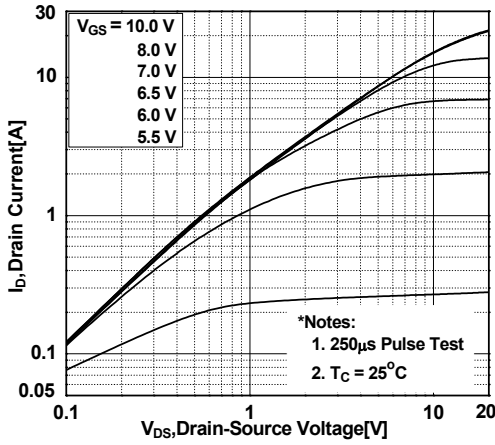


Figure 2. Transfer Characteristics

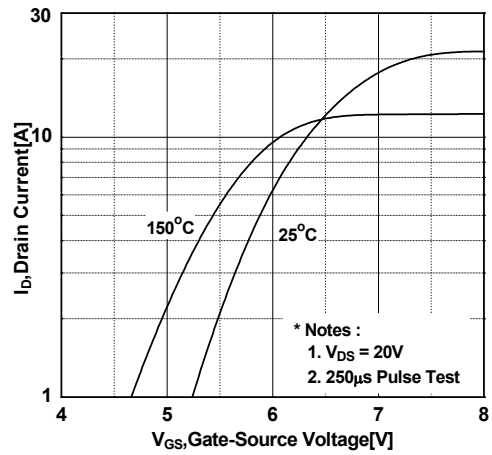


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

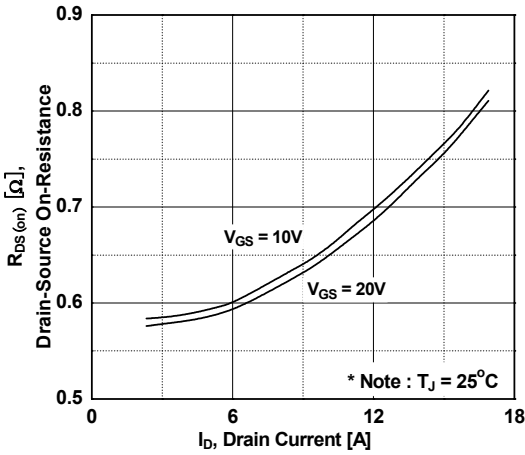


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

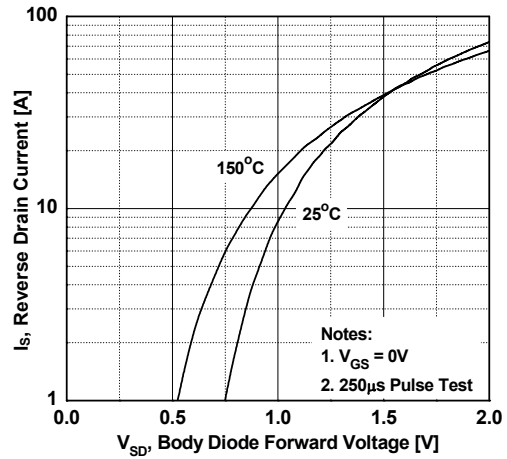


Figure 5. Capacitance Characteristics

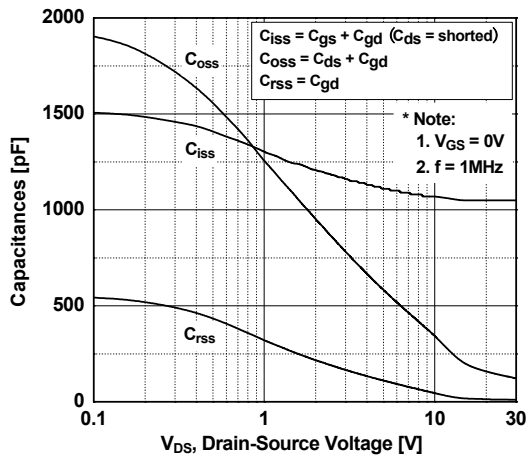
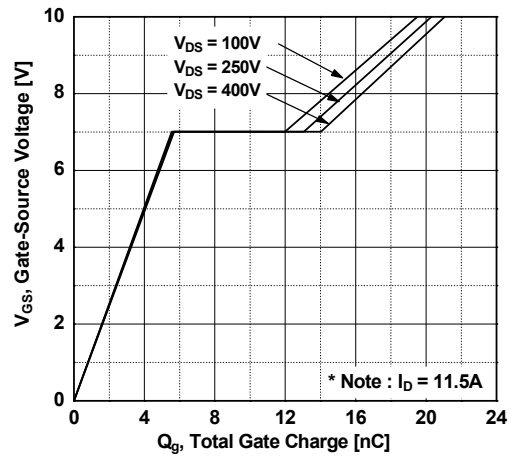


Figure 6. Gate Charge Characteristics



Typical Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

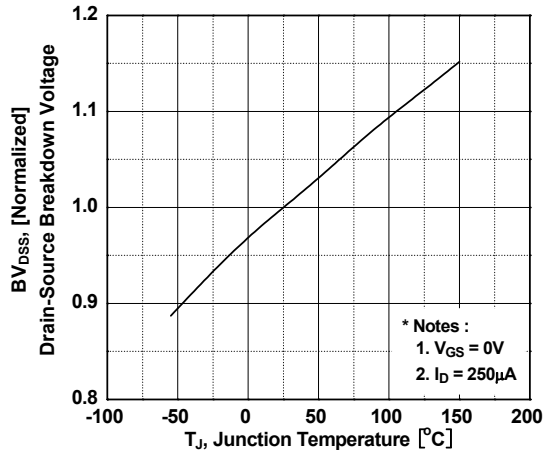


Figure 8. Maximum Safe Operating Area

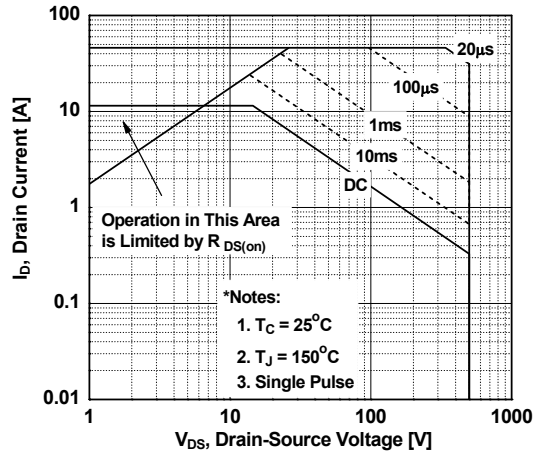


Figure 9. Maximum Drain Current vs. Case Temperature

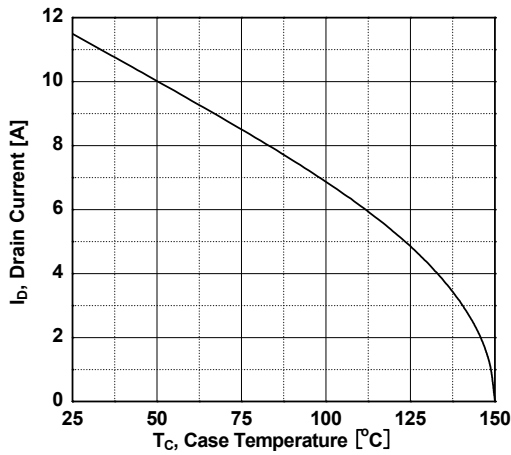


Figure 10. Transient Thermal Response Curve

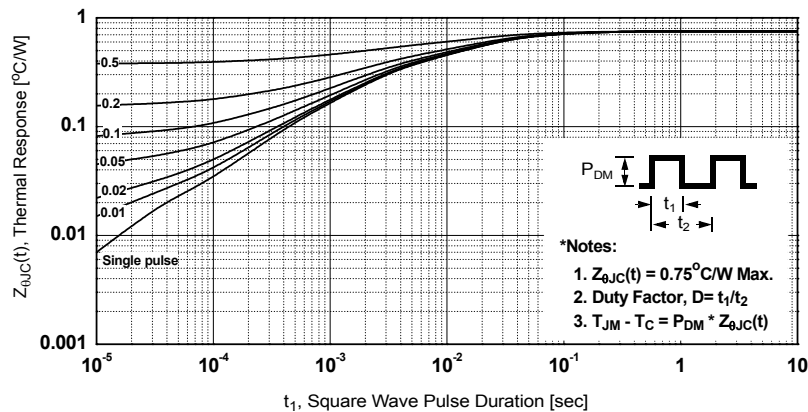


Figure 11. Gate Charge Test Circuit & Waveform

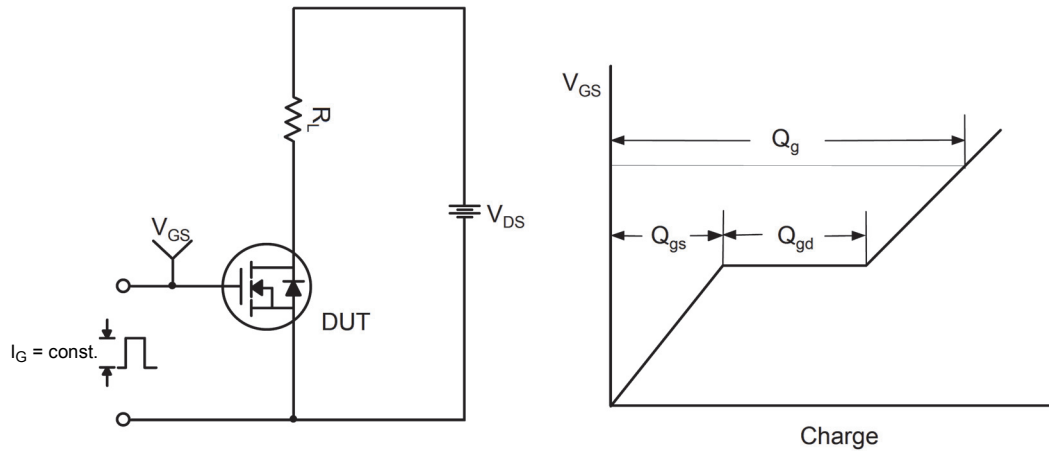


Figure 12. Resistive Switching Test Circuit & Waveforms

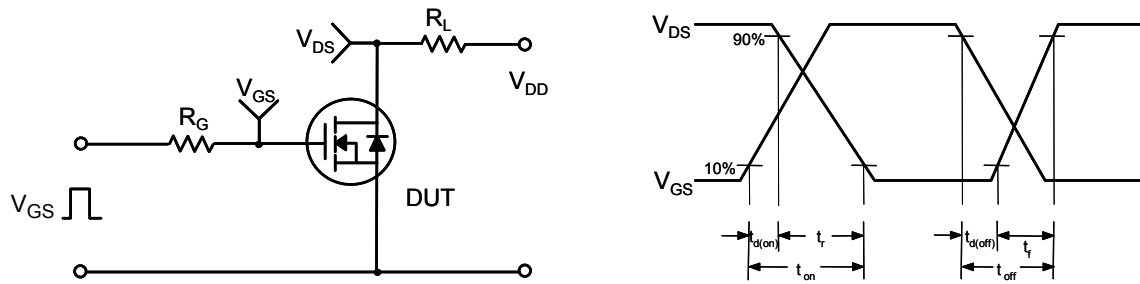


Figure 13. Unclamped Inductive Switching Test Circuit & Waveforms

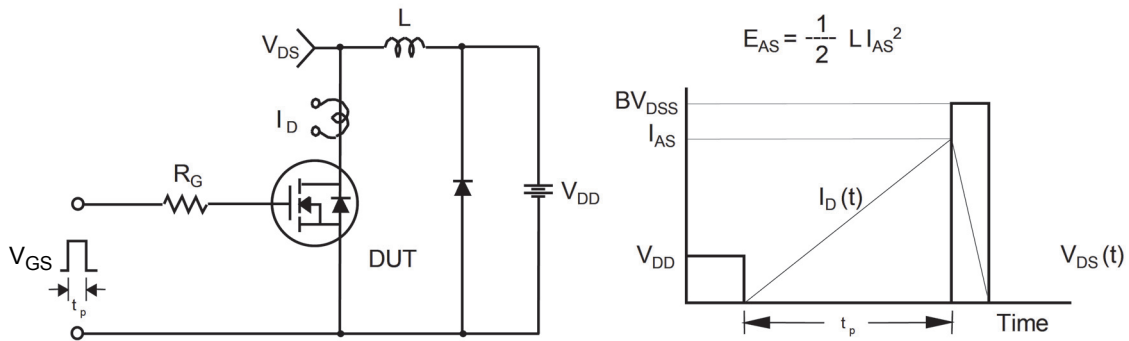
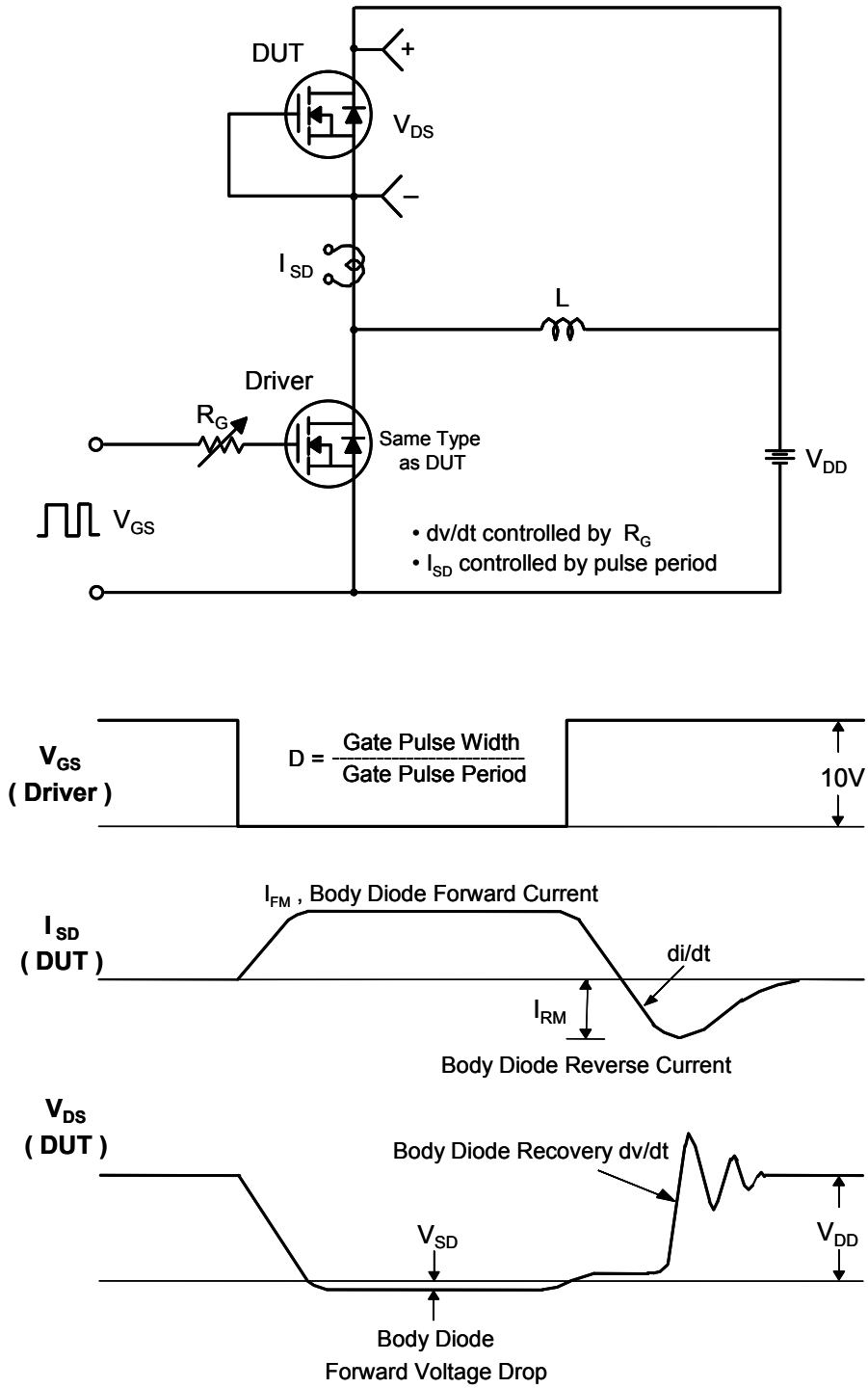


Figure 14. Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

TO-263 2L (D²PAK)



Figure 15. 2LD, TO263, Surface Mount

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Dimension in Millimeters

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