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FAIRCHILD SEMICONDUCTOR®

December 2013

# FDPF10N60ZUT

## N-Channel UniFET$^{TM}$ Ultra FRFET$^{TM}$ MOSFET

**600 V, 9 A, 800 mΩ**

## Features

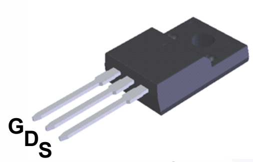
- $R_{DS(on)}$ = 650 mΩ (Typ.) @ $V_{GS}$ = 10 V, $I_D$ = 4.5 A
- Low Gate Charge (Typ. 31 nC)
- Low $C_{rss}$ (Typ. 15 pF)
- 100% Avalanche Tested
- Improved dv/dt Capability
- RoHS Compliant

## Applications

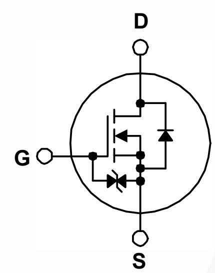
- LCD/LED/PDP TV
- Lighting
- Uninterruptible Power Supply

## Description

UniFET$^{TM}$ II MOSFET is Fairchild Semiconductor's high voltage MOSFET family based on advanced planar stripe and DMOS technology. This advanced MOSFET family has the smallest on-state resistance among the planar MOSFET, and also provides superior switching performance and higher avalanche energy strength. In addition, internal gate-source ESD diode allows UniFET II MOSFET to withstand over 2kV HBM surge stress. UniFET II Ultra FRFET$^{TM}$ MOSFET has much superior body diode reverse recovery performance. Its $t_{rr}$ is less than 50nsec and the reverse dv/dt immunity is 20V/nsec while normal planar MOSFETs have over 200nsec and 4.5V/nsec respectively. Therefore UniFET II Ultra FRFET MOSFET can remove additional component and improve system reliability in certain applications that require performance improvement of the MOSFET's body diode. 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-220F




## MOSFET Maximum Ratings $T_C$ = 25°C unless otherwise noted.

| Symbol | Parameter | | FDPF10N60ZUT | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage | | 600 | V |
| $V_{GSS}$ | Gate to Source Voltage | | ±30 | V |
| $I_D$ | Drain Current | - Continuous ($T_C$ = 25°C) | 9* | A |
| | | - Continuous ($T_C$ = 100°C) | 5.4* | |
| $I_{DM}$ | Drain Current | - Pulsed (Note 1) | 36* | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy (Note 2) | | 100 | mJ |
| $I_{AR}$ | Avalanche Current (Note 1) | | 9 | A |
| $E_{AR}$ | Repetitive Avalanche Energy (Note 1) | | 18 | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | | 20 | V/ns |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C) | 42 | W |
| | | - Derate Above 25°C | 0.3 | 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 |

*Drain current limited by maximum junction temperature.

## Thermal Characteristics

| Symbol | Parameter | FDPF10N60ZUT | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 3.0 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 62.5 | |

## Package Marking and Ordering Information

| Part Number | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|---|
| FDPF10N60ZUT | FDPF10N60ZUT | TO-220F | Tube | N/A | N/A | 50 units |

## Electrical Characteristics $T_C = 25^oC$ unless otherwise noted.

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

### Off Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = 250 μA, $V_{GS}$ = 0 V, $T_J$ = 25°C | 600 | - | - | V |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | - | 0.8 | - | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 600 V, $V_{GS}$ = 0 V | - | - | 25 | μA |
| | | $V_{DS}$ = 480 V, $T_C$ = 125°C | - | - | 250 | |
| $I_{GSS}$ | Gate to Body Leakage Current | $V_{GS}$ = ±30 V, $V_{DS}$ = 0 V | - | - | ±10 | μA |

### On Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | 3.0 | - | 5.0 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 10 V, $I_D$ = 4.5 A | - | 0.65 | 0.80 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 40 V, $I_D$ = 4.5 A | - | 12.5 | - | S |

### Dynamic Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1 MHz | - | 1490 | 1980 | pF |
| $C_{oss}$ | Output Capacitance | | - | 230 | 240 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 15 | 25 | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10V | $V_{DS}$ = 480 V, $I_D$ = 10 A, $V_{GS}$ = 10 V (Note 4) | - | 31 | 40 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | - | 8 | - | nC |
| $Q_{gd}$ | Gate to Drain "Miller" Charge | | - | 12 | - | nC |

### Switching Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 300 V, $I_D$ = 10 A, $R_G$ = 25 Ω , $V_{GS}$ = 10 V (Note 4) | - | 25 | 60 | ns |
| $t_r$ | Turn-On Rise Time | | - | 40 | 90 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 95 | 200 | ns |
| $t_f$ | Turn-Off Fall Time | | - | 60 | 130 | ns |

### Drain-Source Diode Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_S$ | Maximum Continuous Drain to Source Diode Forward Current | | - | - | 9* | A |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current | | - | - | 36 | A |
| $V_{SD}$ | Drain to Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 10 A | - | - | 1.6 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_{SD}$ = 10 A, $dI_F/dt$ = 100 A/μs | - | 45 | - | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 52 | - | nC |

**Notes:**
1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. L = 2 mH, $I_{AS}$ = 10 A, $V_{DD}$ = 50 V, $R_G$ = 25 Ω, starting $T_J$ = 25°C.
3. $I_{SD} \leq$ 10 A, di/dt ≤ 200 A/μs, $V_{DD} \leq BV_{DSS}$, starting $T_J$ = 25°C.
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

**Figure 1. On-Region Characteristics**

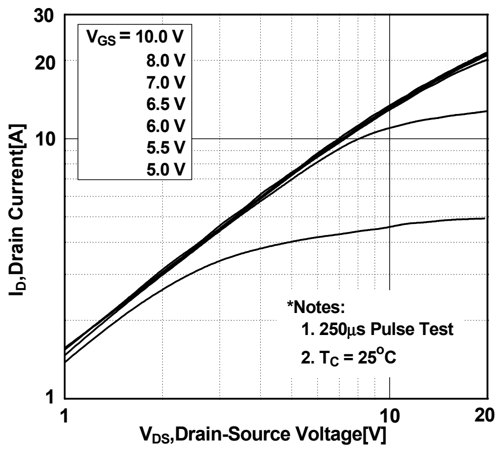



**Figure 2. Transfer Characteristics**

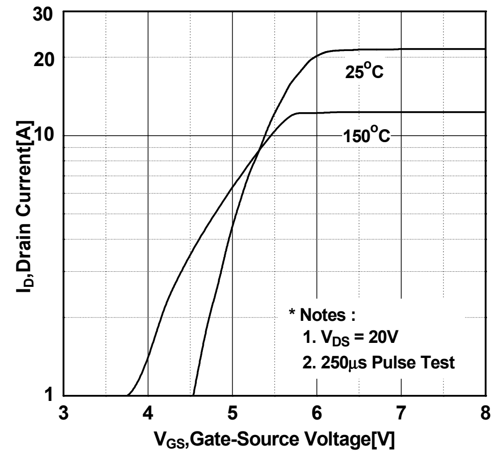



**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**

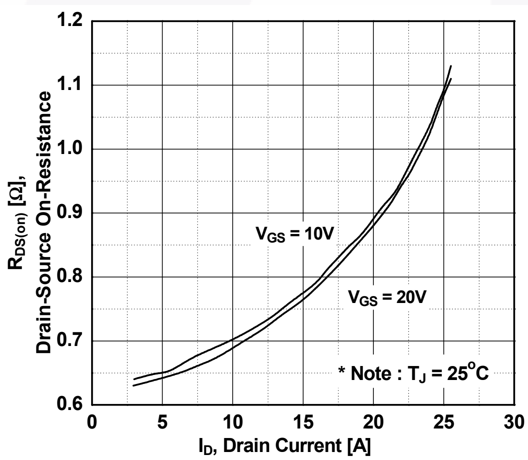



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

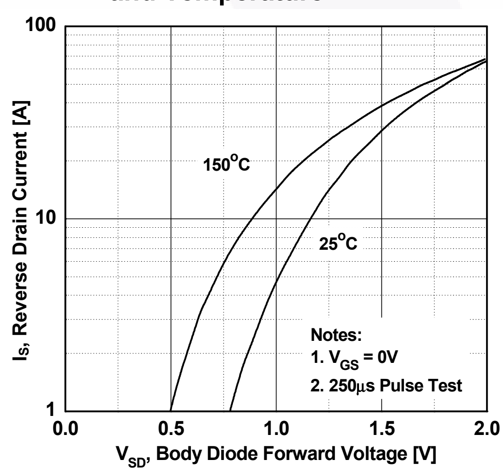



**Figure 5. Capacitance Characteristics**

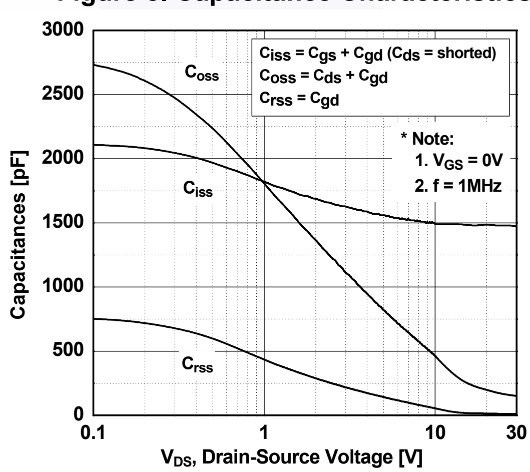
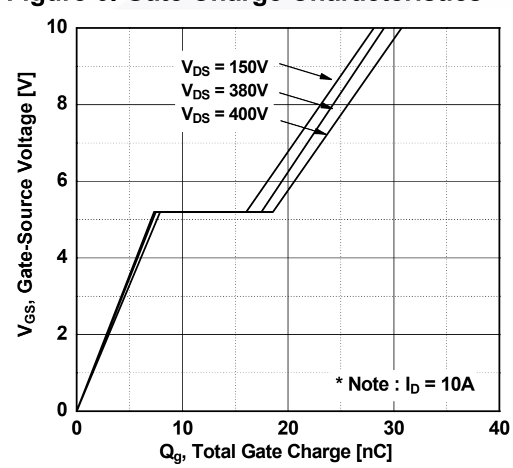



**Figure 6. Gate Charge Characteristics**



## Typical Performance Characteristics (Continued)

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

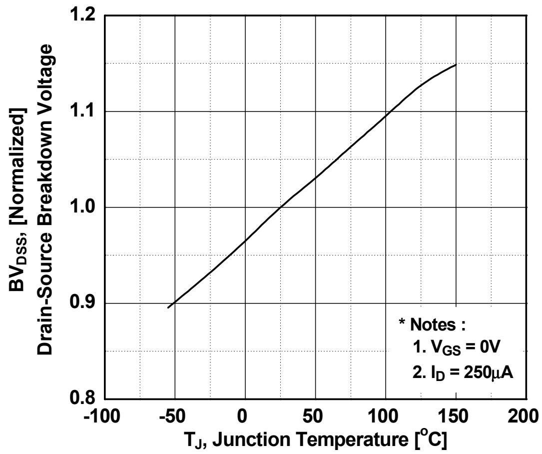



**Figure 8. Maximum Safe Operating Area**

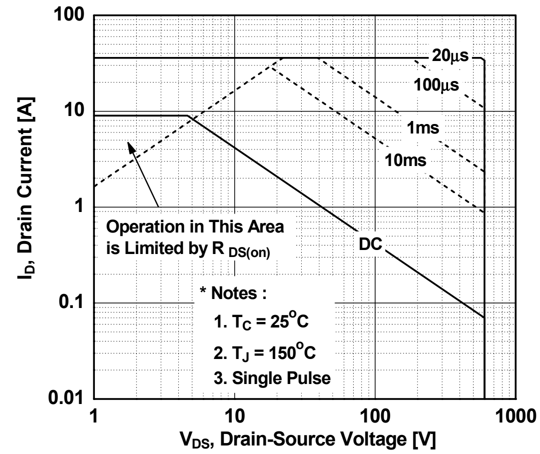



**Figure 9. Maximum Drain Current vs. Case Temperature**

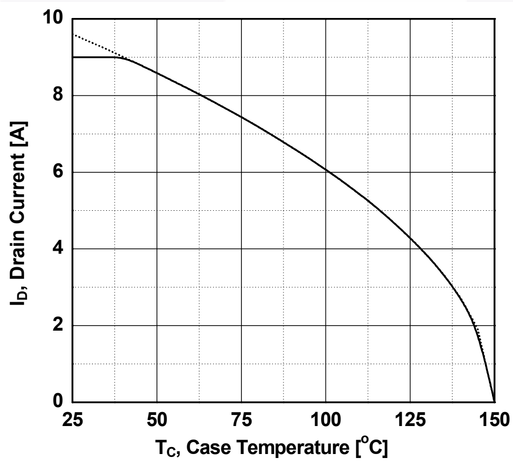
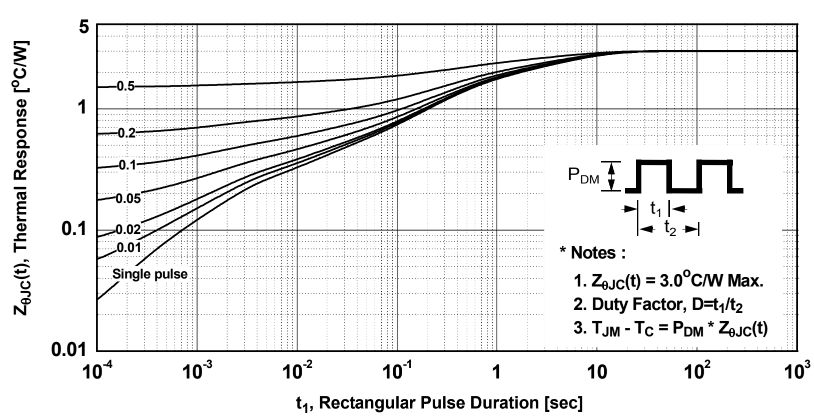



**Figure 10. Transient Thermal Response Curve**



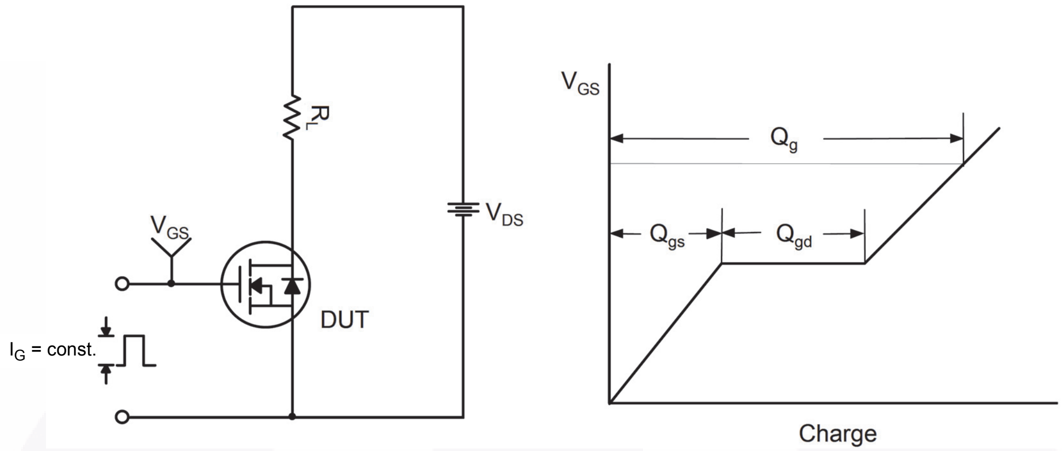



**Figure 11. Gate Charge Test Circuit & Waveform**

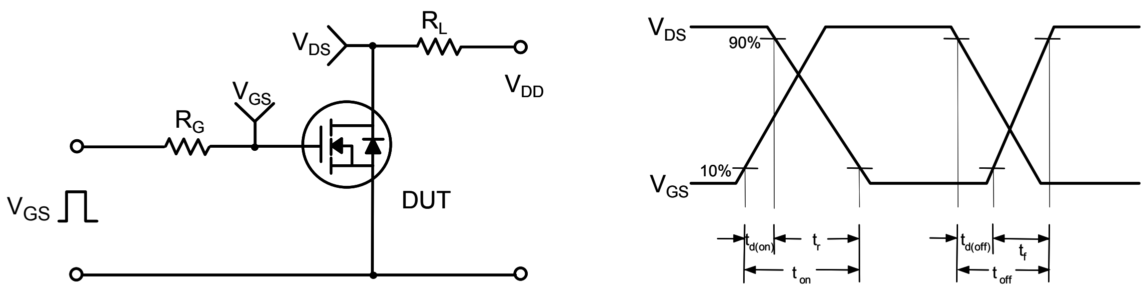



**Figure 12. Resistive Switching Test Circuit & Waveforms**

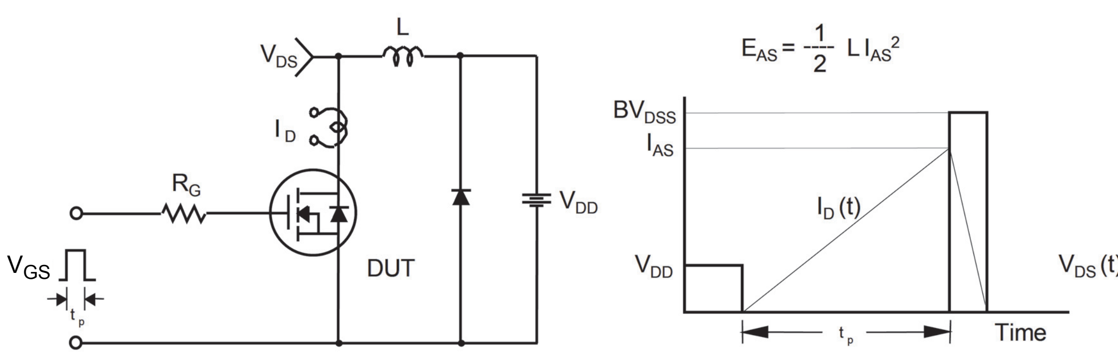



**Figure 13. Unclamped Inductive Switching Test Circuit & Waveforms**

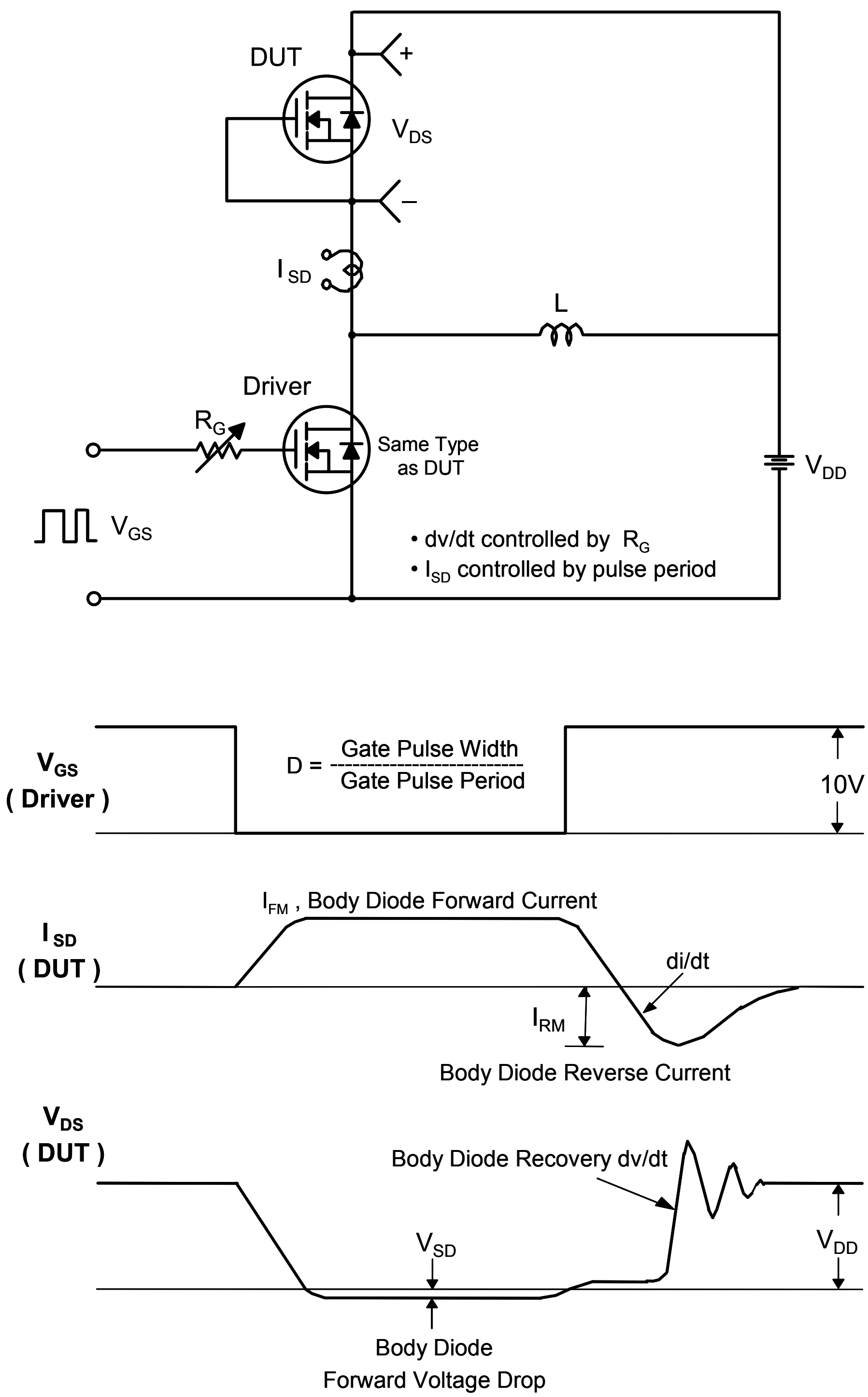



**Figure 14. Peak Diode Recovery dv/dt Test Circuit & Waveforms**

## Mechanical Dimensions

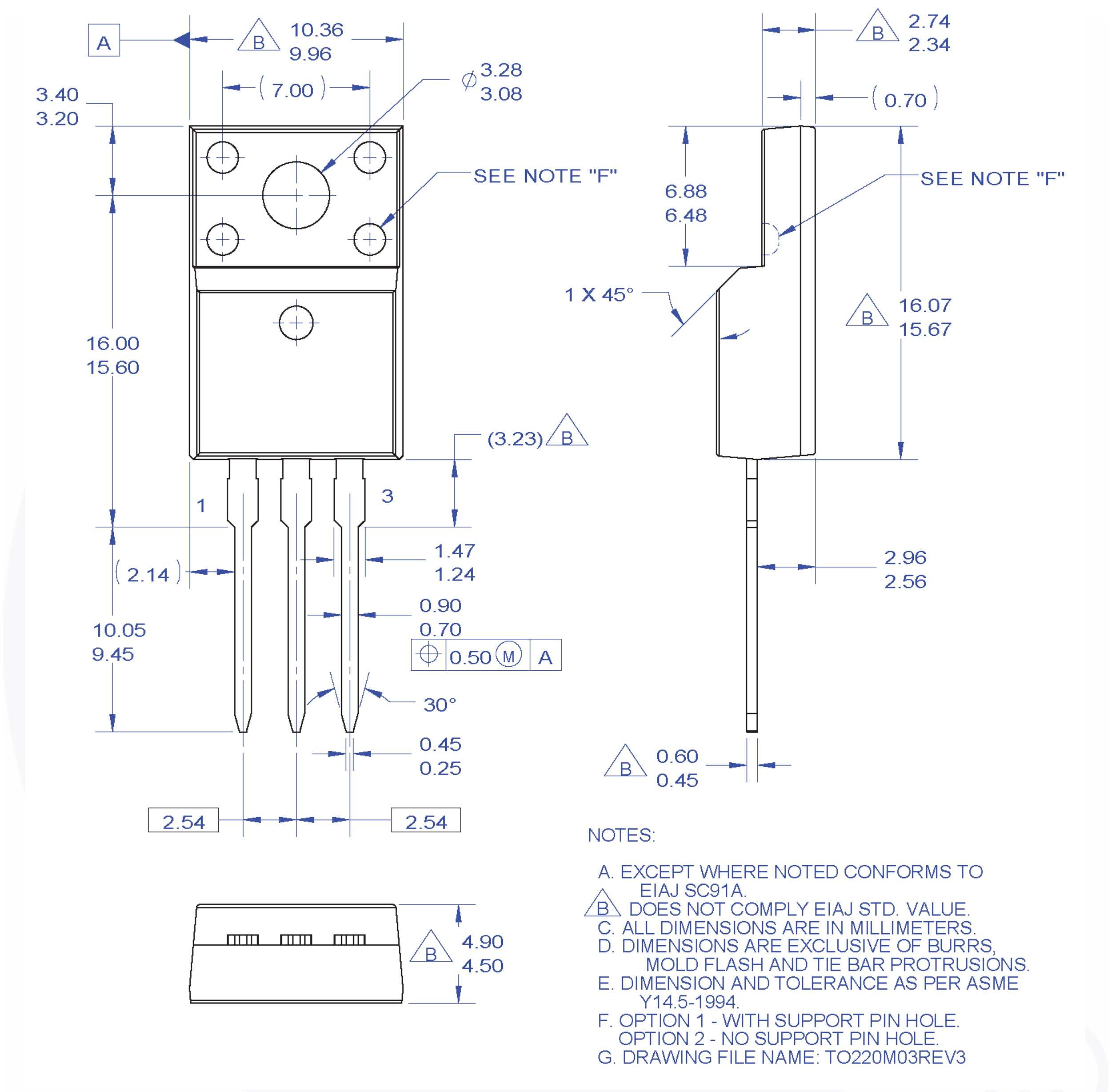



**Figure 15. TO220, Molded, 3-Lead, Full Pack, EIAJ SC91, Straight Lead**

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