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FAIRCHILD SEMICONDUCTOR®

December 2013

# FDPF3860T

## N-Channel PowerTrench® MOSFET

### 100 V, 20 A, 38.2 mΩ

## Features

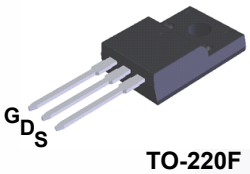
- $R_{DS(on)}$ = 29.1 mΩ (Typ.) @ $V_{GS}$ = 10 V, $I_D$ = 5.9 A
- Fast Switching Speed
- Low Gate Charge
- High Performance Trench Technology for Extremely Low $R_{DS(on)}$
- High Power and Current Handling Capability
- RoHS Compliant

## Description

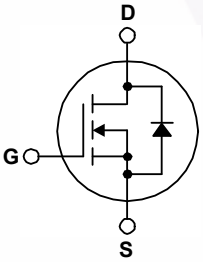
This N-Channel MOSFET is produced using Fairchild Semiconductor's advanced PowerTrench® process that has been tailored to minimize the on-state resistance while maintaining superior switching performance.

## Applications

- Consumer Appliances
- LCD/LED/PDP TV
- Synchronous Rectification
- Uninterruptible Power Supply
- Micro Solar Inverter




TO-220F




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

| Symbol | Parameter | | | FDPF3860T | Unit |
|---|---|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage | | | 100 | V |
| $V_{GSS}$ | Gate to Source Voltage | | | ±20 | V |
| $I_D$ | Drain Current | - Continuous ($T_C$ = 25°C) | | 20 | A |
| | | - Continuous ($T_C$ = 100°C) | | 12.7 | |
| $I_{DM}$ | Drain Current | - Pulsed | (Note 1) | 80 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy | | (Note 2) | 278 | mJ |
| $I_{AR}$ | Avalanche Current | | (Note 1) | 20 | A |
| $E_{AR}$ | Repetitive Avalanche Energy | | (Note 1) | 3.4 | mJ |
| dv/dt | Peak Diode Recovery dv/dt | | (Note 3) | 15 | V/ns |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C) | | 33.8 | W |
| | | - Derate Above 25°C | | 0.27 | 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 | FDPF3860T | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 3.7 | °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 |
|---|---|---|---|---|---|---|
| FDPF3860T | FDPF3860T | 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** | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = 250 μA, $V_{GS}$ = 0 V, $T_J = 25^oC$ | 100 | - | - | V |
| $\Delta BV_{DSS}$ / $\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to $25^oC$ | - | 0.1 | - | $V/^oC$ |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 80 V, $V_{GS}$ = 0 V | - | - | 1 | μA |
| | | $V_{DS}$ = 48 V, $T_C = 150^oC$ | - | - | 500 | |
| $I_{GSS}$ | Gate to Body Leakage Current | $V_{GS}$ = ±20 V, $V_{DS}$ = 0 V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS} = V_{DS}$, $I_D$ = 250 μA | 2.5 | - | 4.5 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 10 V, $I_D$ = 5.9 A | - | 29.1 | 38.2 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 10 V, $I_D$ = 5.9 A | - | 21 | - | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1 MHz | - | 1350 | 1800 | pF |
| $C_{oss}$ | Output Capacitance | | - | 145 | 190 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 60 | 90 | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 50 V, $I_D$ = 5.9 A, $V_{GS}$ = 10 V, $R_G$ = 6 Ω (Note 4) | - | 15 | 40 | ns |
| $t_r$ | Turn-On Rise Time | | - | 17 | 45 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 24 | 60 | ns |
| $t_f$ | Turn-Off Fall Time | | - | 7 | 25 | ns |
| $Q_{g(tot)}$ | Total Gate Charge at 10V | $V_{DS}$ = 80 V, $I_D$ = 5.9 A, $V_{GS}$ = 10 V (Note 4) | - | 23 | 35 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | - | 7 | - | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | - | 8 | - | nC |
| **Drain-Source Diode Characteristics** | | | | | | |
| $I_S$ | Maximum Continuous Drain to Source Diode Forward Current | | - | - | 20 | A |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current | | - | - | 80 | A |
| $V_{SD}$ | Drain to Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 5.9 A | - | - | 1.3 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_{SD}$ = 5.9 A, $dI_F/dt$ = 100 A/μs | - | 40 | - | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 56 | - | nC |

**Notes:**

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. L = 16 mH, $I_{AS}$ = 5.9 A, $V_{DD}$ = 50 V, $R_G$ = 25 Ω, starting $T_J = 25°C$.
3. $I_{SD} \le 5.9$ A, di/dt ≤ 200 A/μs, $V_{DD} \le BV_{DSS}$, starting $T_J = 25°C$.
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

**Figure 1. On-Region Characteristics**

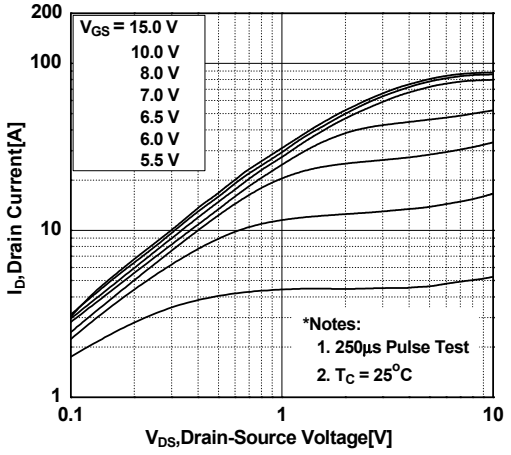



**Figure 2. Transfer Characteristics**

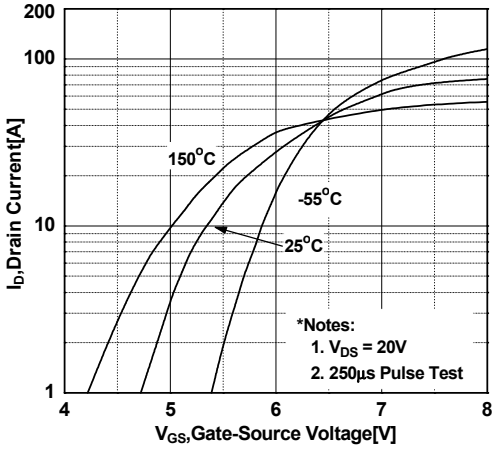



**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**

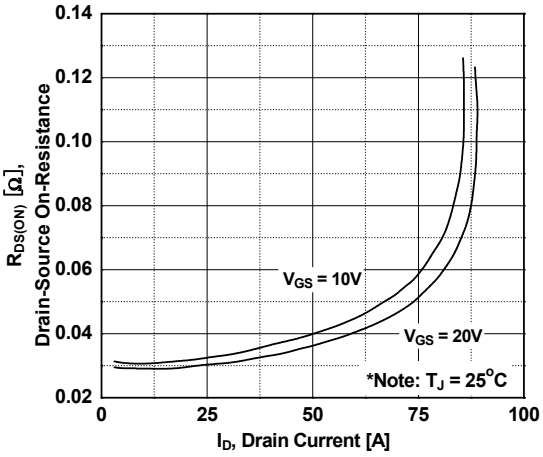



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

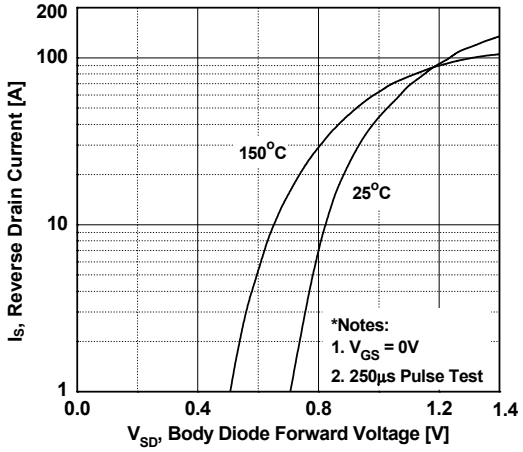



**Figure 5. Capacitance Characteristics**

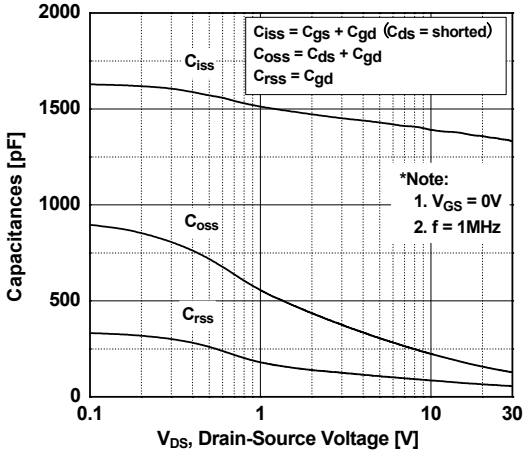
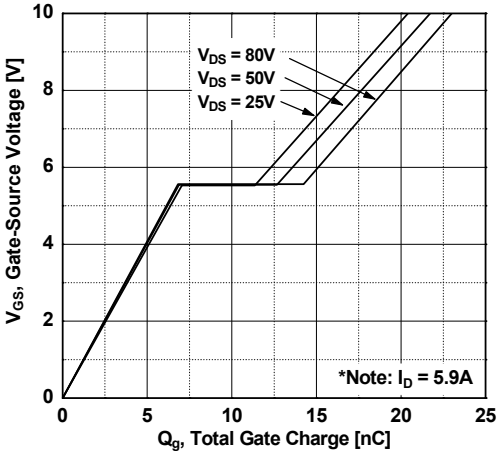



**Figure 6. Gate Charge Characteristics**



## Typical Performance Characteristics (Continued)

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

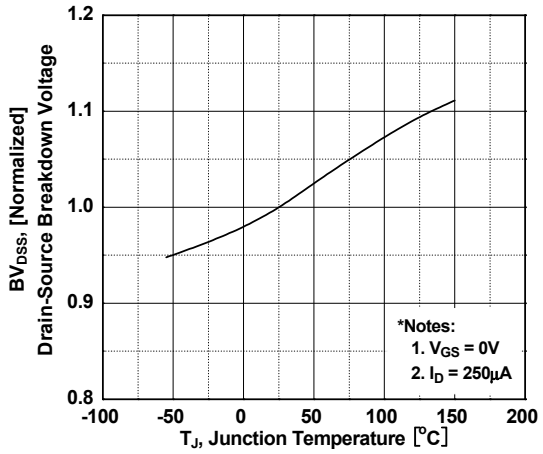



**Figure 8. On-Resistance Variation vs. Temperature**

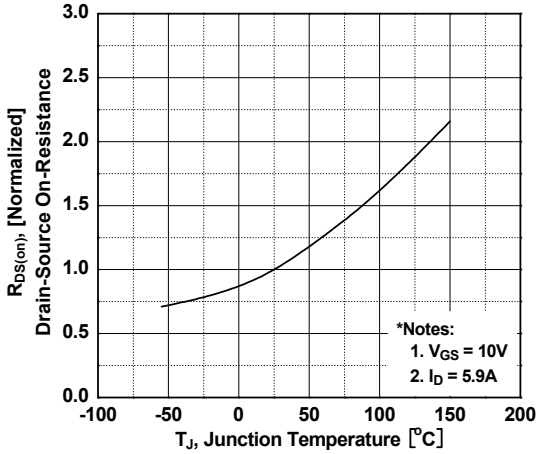



**Figure 9. Maximum Safe Operating Area**

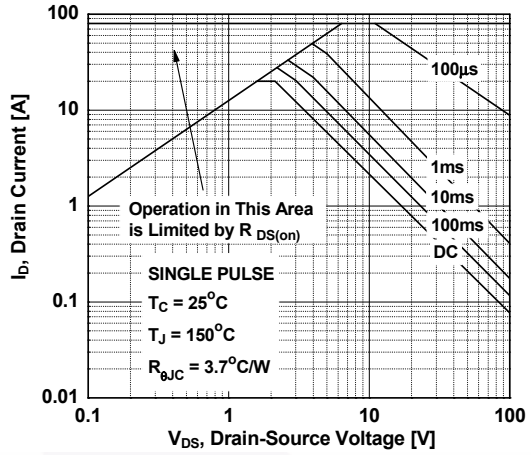



**Figure 10. Maximum Drain Current vs. Case Temperature**

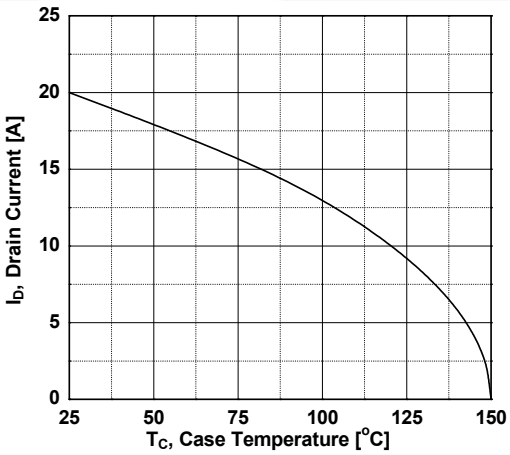
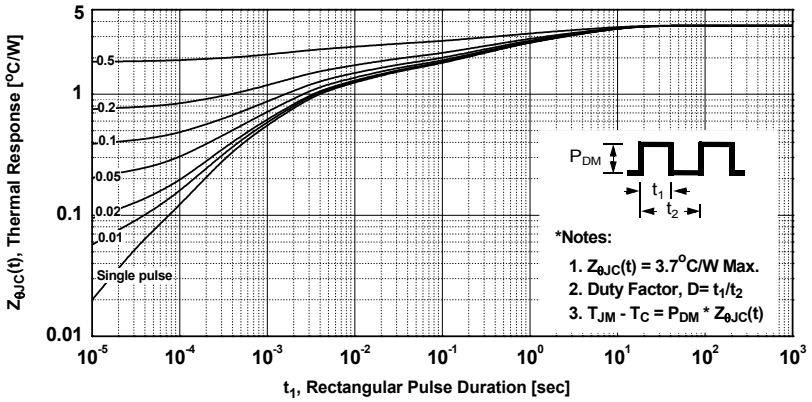



**Figure 11. Transient Thermal Response Curve**



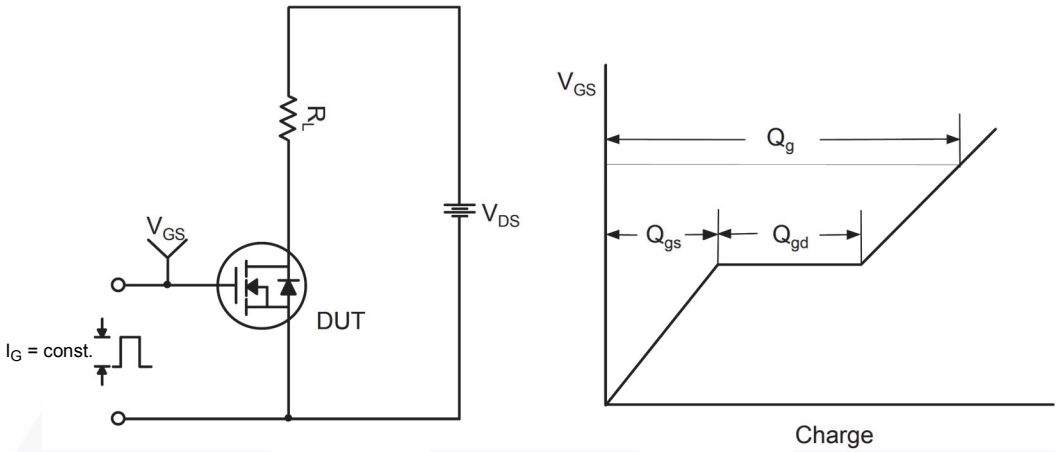



**Figure 12. Gate Charge Test Circuit & Waveform**

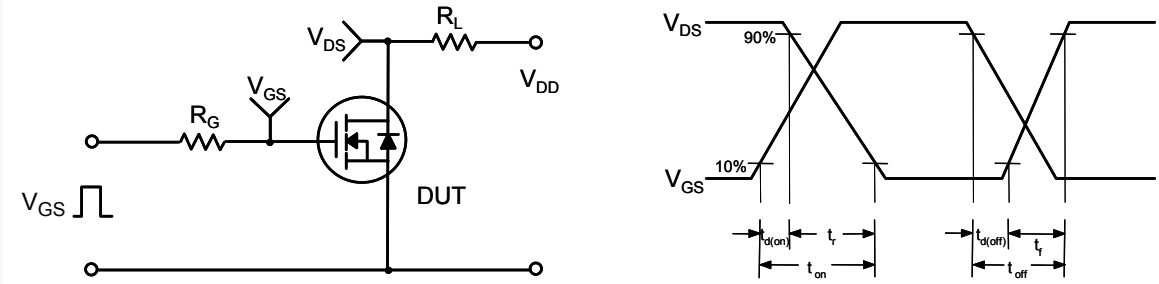



**Figure 13. Resistive Switching Test Circuit & Waveforms**

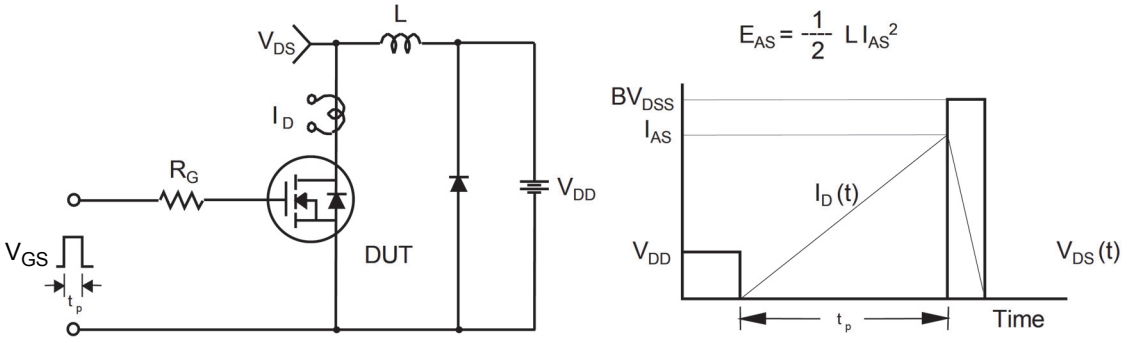



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

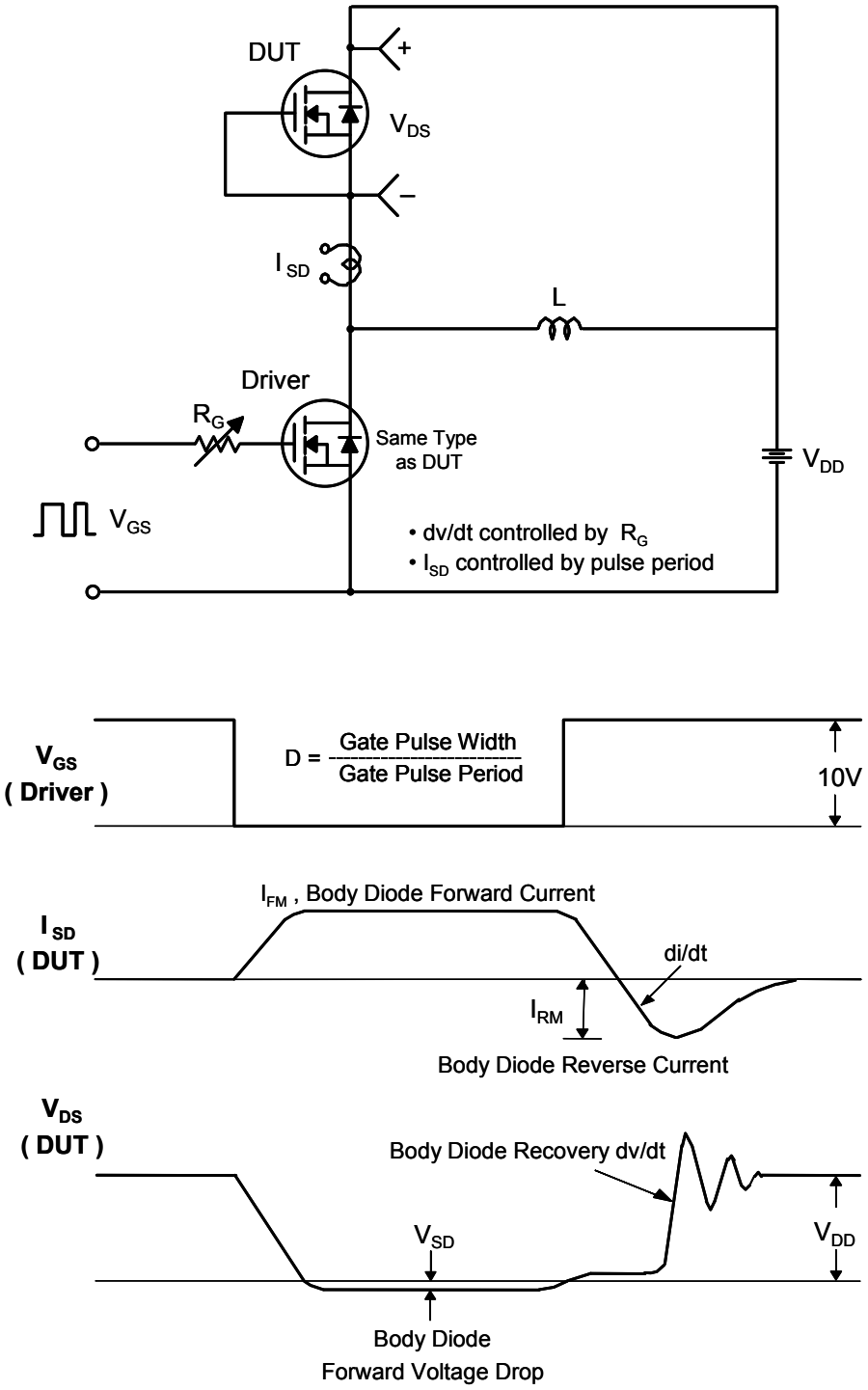



**Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms**

## Mechanical Dimensions

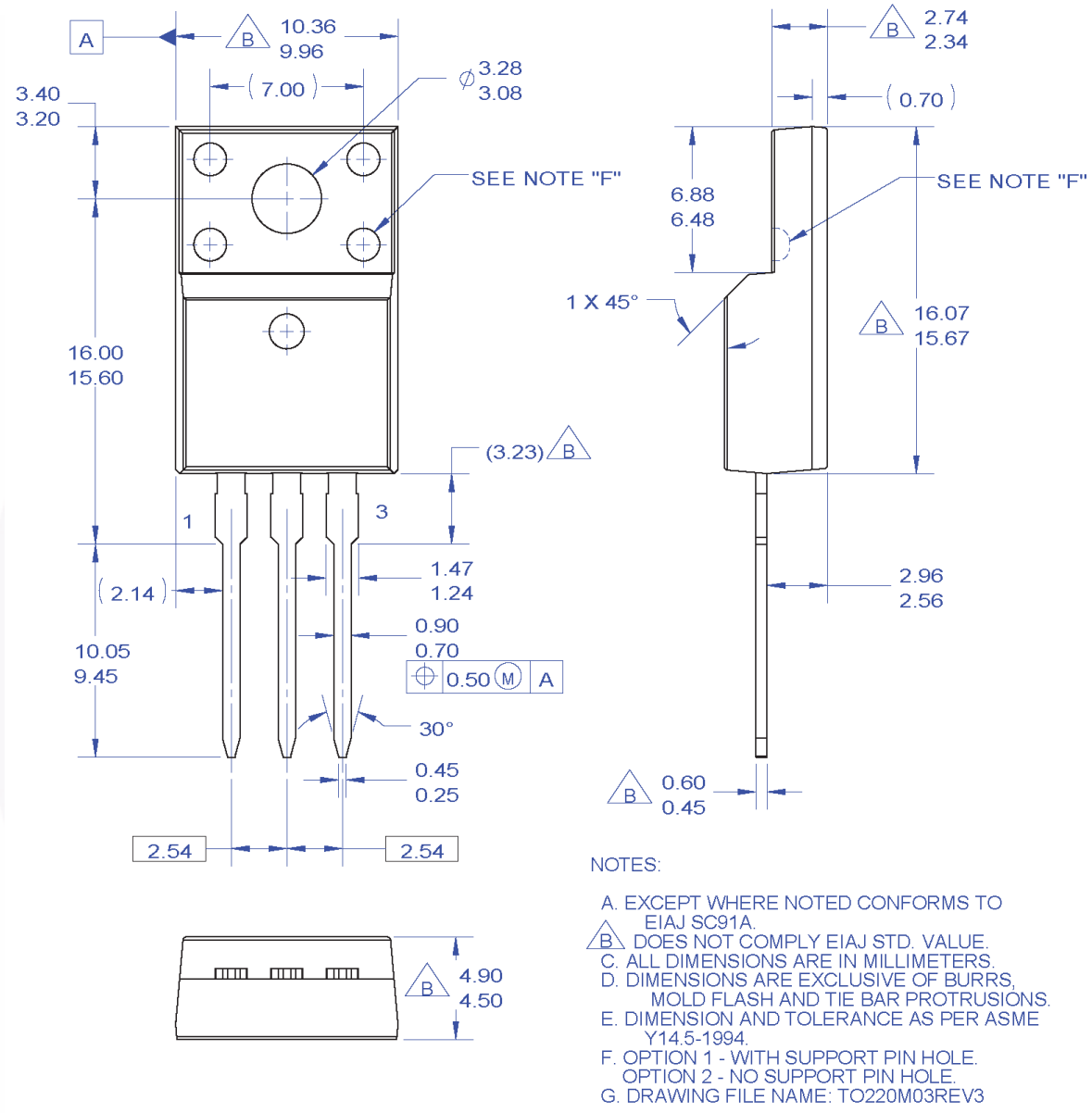



**Figure 16. TO220, Molded, 3-Lead, Full Pack, EIAJ SC91, Straight Lead**

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Rev. I66

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