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December 2014

# FDPF041N06BL1

## N-Channel PowerTrench® MOSFET

**60 V, 77 A, 4.1 mΩ**

## Features

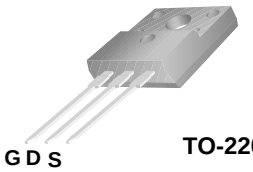
- $R_{DS(on)}$ = 3.5 mΩ ( Typ.) @ $V_{GS}$ = 10 V, $I_D$ = 77 A
- Low FOM $R_{DS(on)}$*$Q_G$
- Low Reverse Recovery Charge, $Q_{rr}$
- Soft Reverse Recovery Body Diode
- Enables Highly Efficiency in Synchronous Rectification
- Fast Switching Speed
- 100% UIL Tested
- RoHS Compliant

## Description

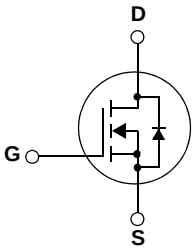
This N-Channel MOSFET is produced using Fairchild Semiconductor®'s advanced PowerTrench® process that has been tailored to minimize the on-state resistance while maintaining superior switching performance.

## Applications

- Synchronous Rectification for ATX / Server / Telecom PSU
- Battery Protection Circuit
- Motor Drives and Uninterruptible Power Supplies
- Renewable System




TO-220F




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

| Symbol | Parameter | | FDPF041N06BL1 | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage | | 60 | V |
| $V_{GSS}$ | Gate to Source Voltage | | ±20 | V |
| $I_D$ | Drain Current | - Continuous ($T_C$ = 25°C, Silicon Limited) | 77 | A |
| | | - Continuous ($T_C$ = 100°C, Silicon Limited) | 55 | |
| $I_{DM}$ | Drain Current | - Pulsed (Note 1) | 308 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy | (Note 2) | 365 | mJ |
| dv/dt | Peak Diode Recovery dv/dt | (Note 3) | 6.0 | V/ns |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C) | 44.1 | W |
| | | - Derate above 25°C | 0.29 | W/°C |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | -55 to +175 | °C |
| $T_L$ | Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds | | 300 | °C |

## Thermal Characteristics

| Symbol | Parameter | FDPF041N06BL1 | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max | 3.4 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max | 62.5 | |

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## Package Marking and Ordering Information

| Device Marking | Device | Package | Packaging Type | Quantity |
|---|---|---|---|---|
| FDPF041N06BL1 | FDPF041N06BL1 | TO-220F | Tube | 50 |

## 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 | $I_D$ = 250μA, $V_{GS}$ = 0V | 60 | - | - | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250μA, Referenced to 25°C | - | 0.03 | - | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 48V, $V_{GS}$ = 0V | - | - | 1 | μA |
| $I_{GSS}$ | Gate to Body Leakage Current | $V_{GS}$ = ±20V, $V_{DS}$ = 0V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250μA | 2 | - | 4 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 10V, $I_D$ = 77A | - | 3.5 | 4.1 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 10V, $I_D$ = 77A | - | 125 | - | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 30V, $V_{GS}$ = 0V, f = 1MHz | - | 4280 | 5690 | pF |
| $C_{oss}$ | Output Capacitance | | - | 1050 | 1400 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 23 | - | pF |
| $C_{oss(er)}$ | Energy Related Output Capacitance | $V_{DS}$ = 30V, $V_{GS}$ = 0V | - | 1787 | - | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10V | $V_{DS}$ = 30V, $I_D$ = 100A, $V_{GS}$ = 10V | - | 53 | 69 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | - | 23 | - | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | - | 8 | - | nC |
| $V_{plateau}$ | Gate Plateau Volatge | (Note 4) | - | 5.7 | - | V |
| $Q_{sync}$ | Total Gate Charge Sync. | $V_{DS}$ = 0V, $I_D$ = 50A (Note 5) | - | 48.6 | - | nC |
| $Q_{oss}$ | Output Charge | $V_{DS}$ = 30V, $V_{GS}$ = 0V | - | 63.8 | - | nC |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 30V, $I_D$ = 100A, $V_{GS}$ = 10V, $R_{GEN}$ = 4.7Ω | - | 29 | 68 | ns |
| $t_r$ | Turn-On Rise Time | | - | 22 | 54 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 38 | 86 | ns |
| $t_f$ | Turn-Off Fall Time | (Note 4) | - | 11 | 32 | ns |
| ESR | Equivalent Series Resistance (G-S) | f = 1MHz | - | 0.8 | - | Ω |
| **Drain-Source Diode Characteristics** | | | | | | |
| $I_S$ | Maximum Continuous Drain to Source Diode Forward Current | | - | - | 77 | A |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current | | - | - | 308 | A |
| $V_{SD}$ | Drain to Source Diode Forward Voltage | $V_{GS}$ = 0V, $I_{SD}$ = 77A | - | - | 1.25 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0V, $I_{SD}$ = 100A, $dI_F/dt$ = 100A/μs | - | 65 | - | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 63 | - | nC |

**Notes:**

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. L = 3mH, $I_{AS}$ = 15.6A, Starting $T_J$ = 25°C
3. $I_{SD} \le$ 100A, di/dt ≤ 200A/μs, $V_{DD} \le BV_{DSS}$, Starting $T_J$ = 25°C
4. Essentially Independent of Operating Temperature Typical Characteristics
5. See the test circuit in page 8

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## Typical Performance Characteristics

**Figure 1. On-Region Characteristics**

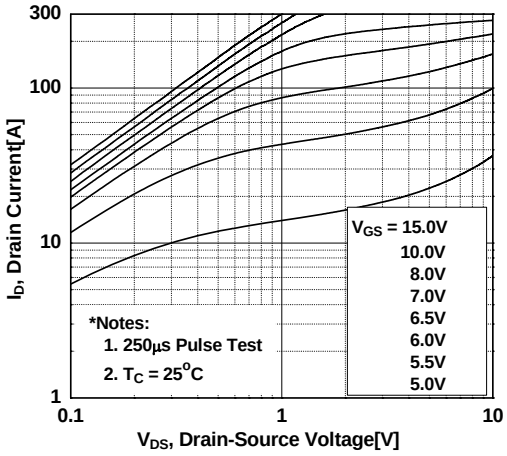



**Figure 2. Transfer Characteristics**

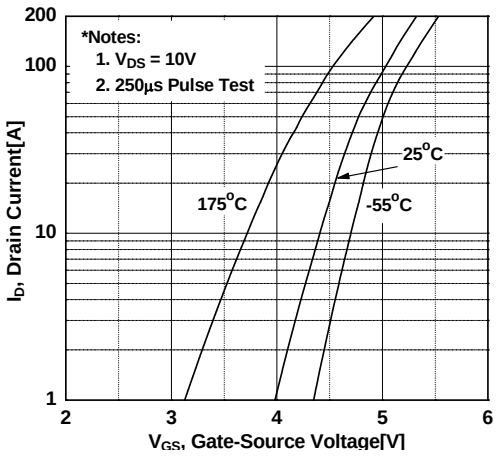



**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**

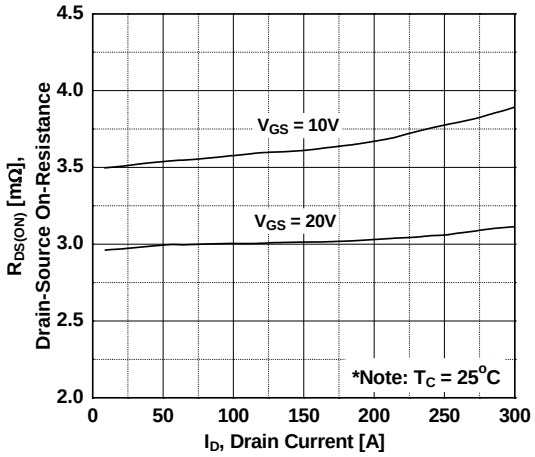



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

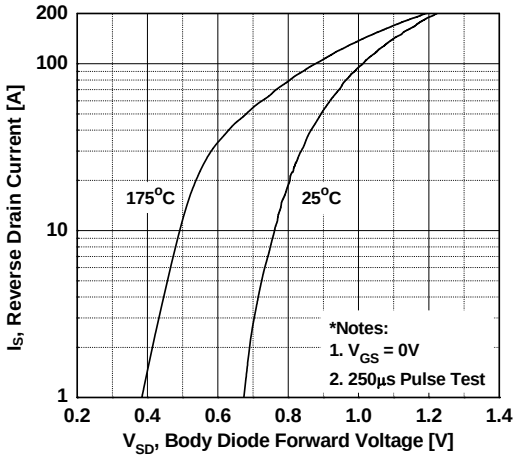



**Figure 5. Capacitance Characteristics**

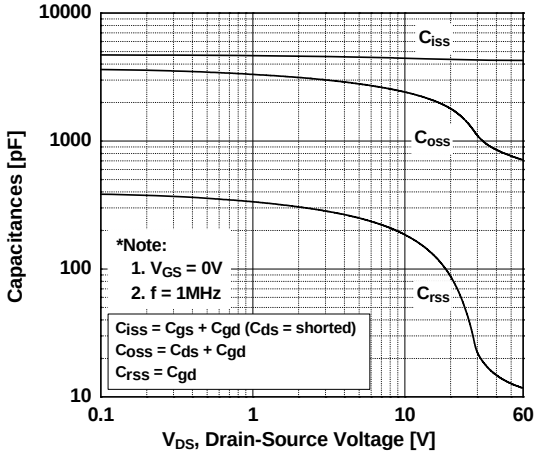
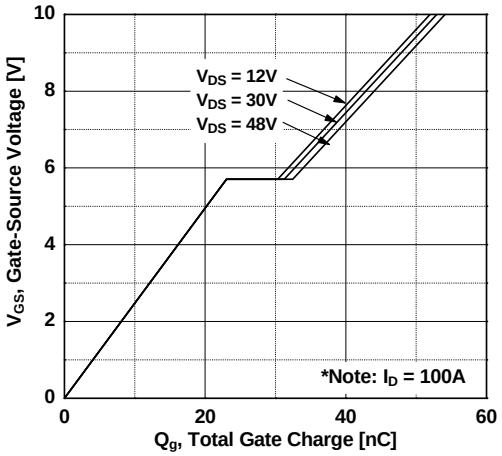



**Figure 6. Gate Charge Characteristics**




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## Typical Performance Characteristics (Continued)

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

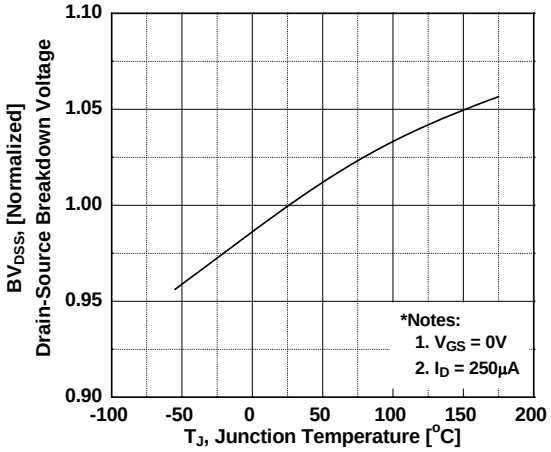



**Figure 8. On-Resistance Variation vs. Temperature**

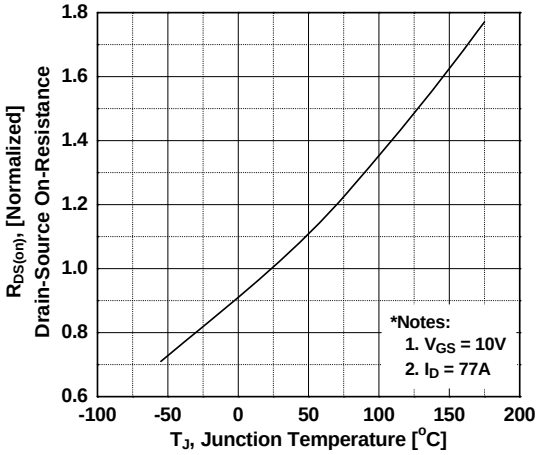



**Figure 9. Maximum Safe Operating Area vs. Case Temperature**

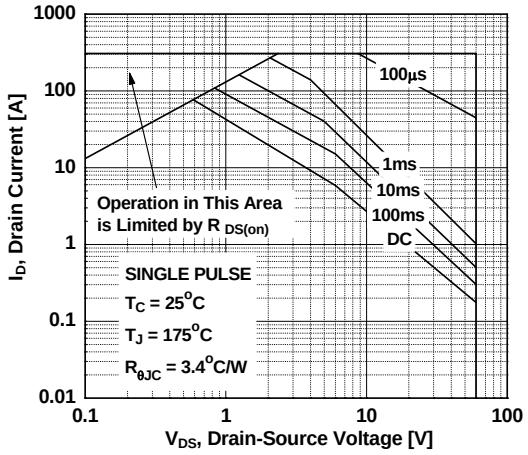



**Figure 10. Maximum Drain Current**

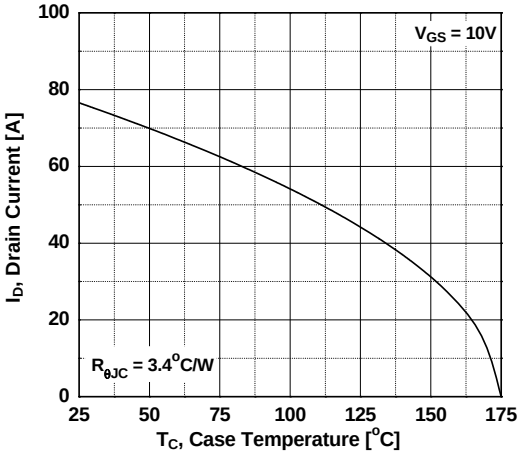



**Figure 11. Eoss vs. Drain to Source Voltage**

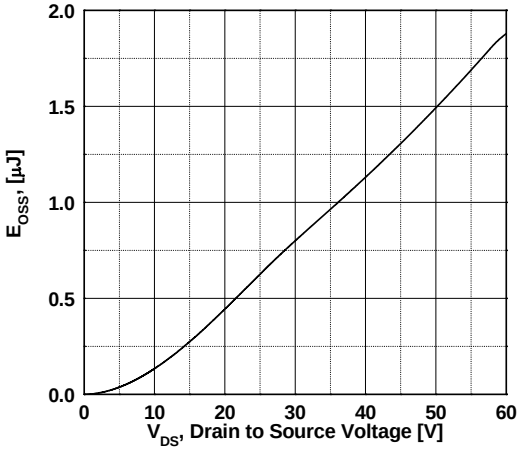
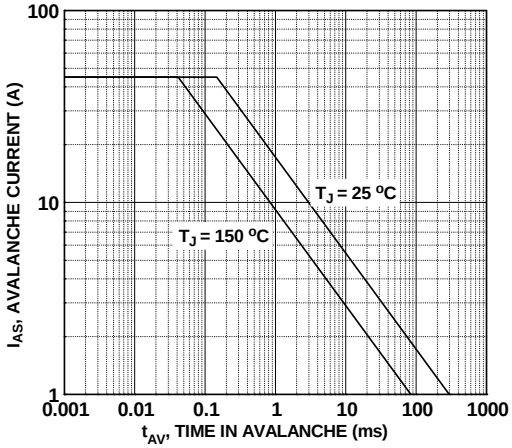


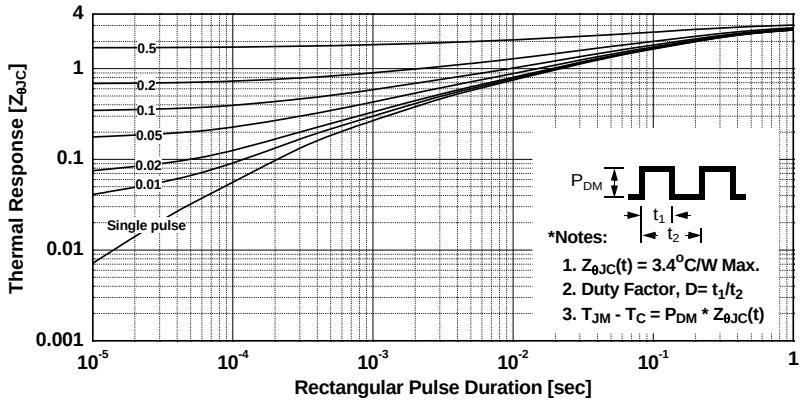

**Figure 12. Unclamped Inductive Switching Capability**



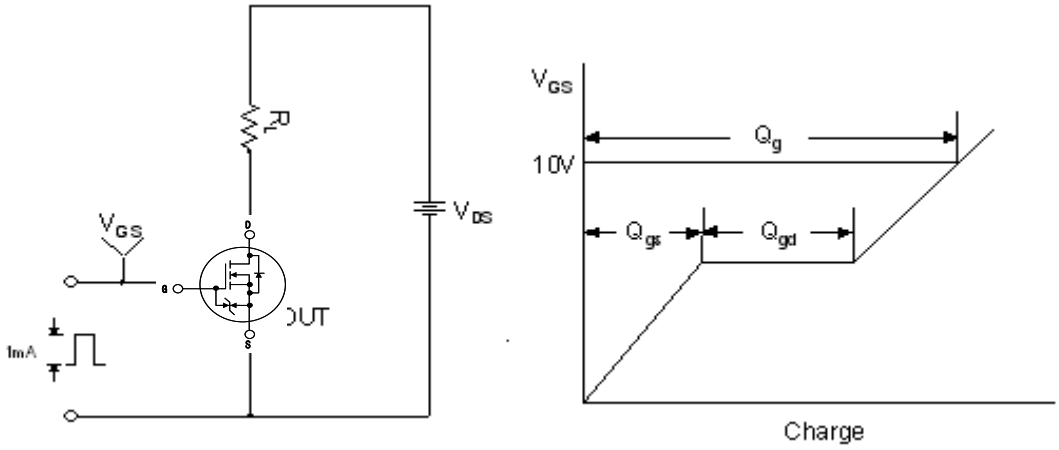

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## Typical Performance Characteristics (Continued)

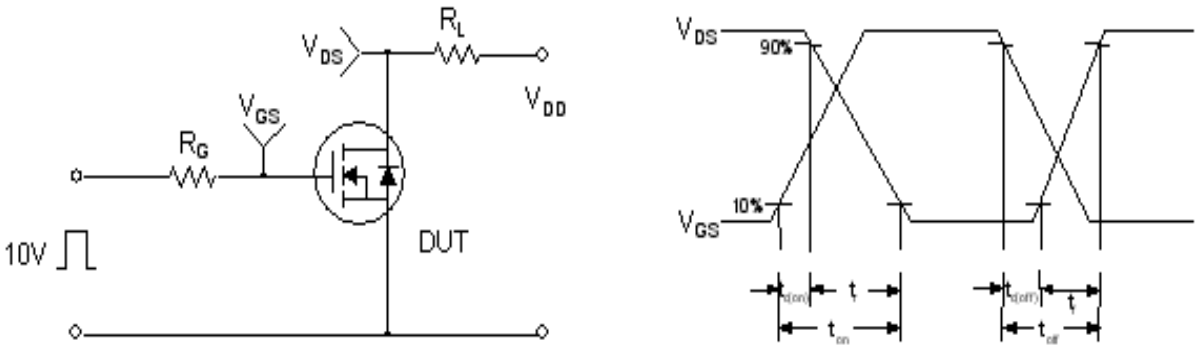
**Figure 13. Transient Thermal Response Curve**



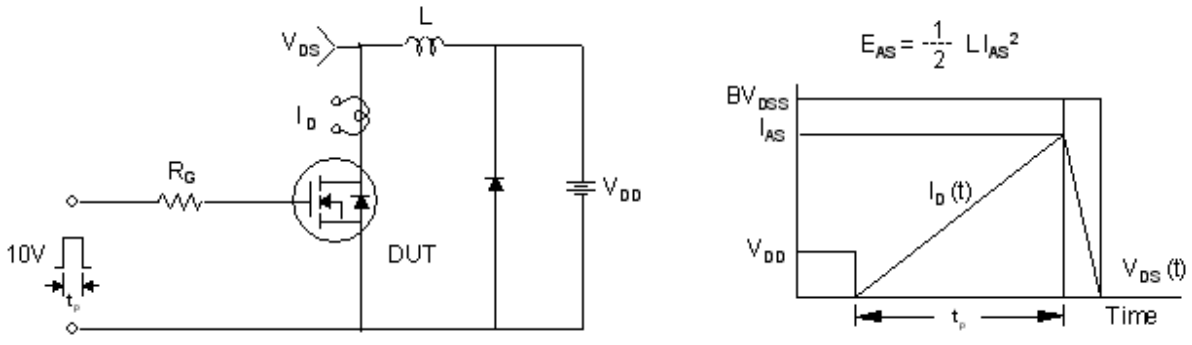
**Gate Charge Test Circuit & Waveform**



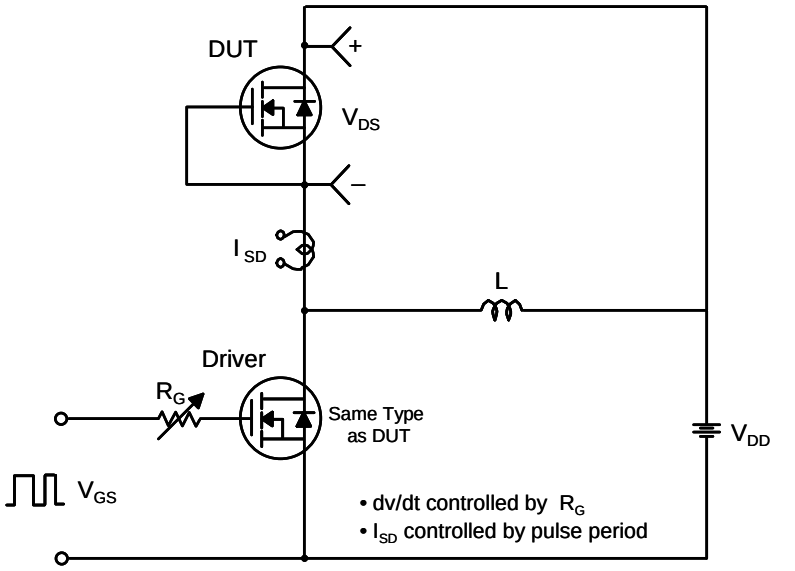

**Resistive Switching Test Circuit & Waveforms**

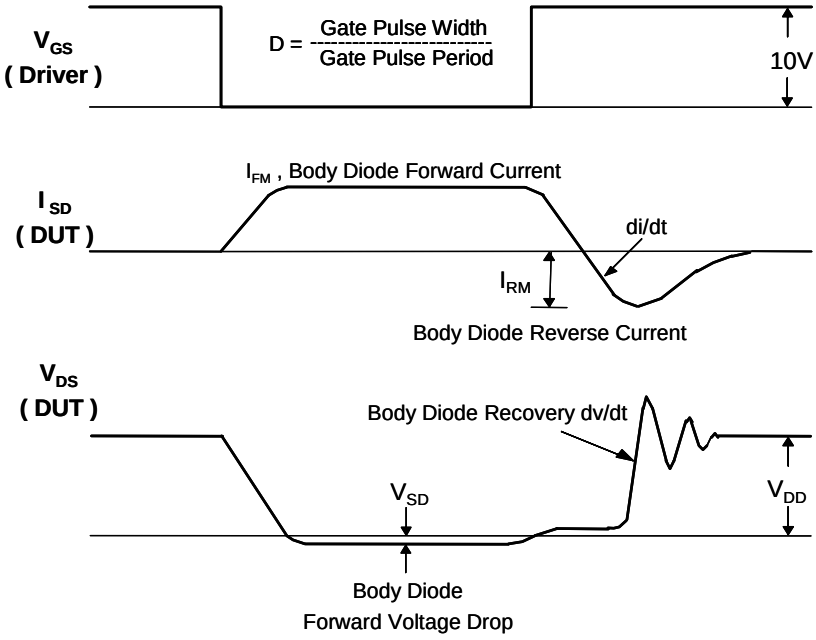



**Unclamped Inductive Switching Test Circuit & Waveforms**

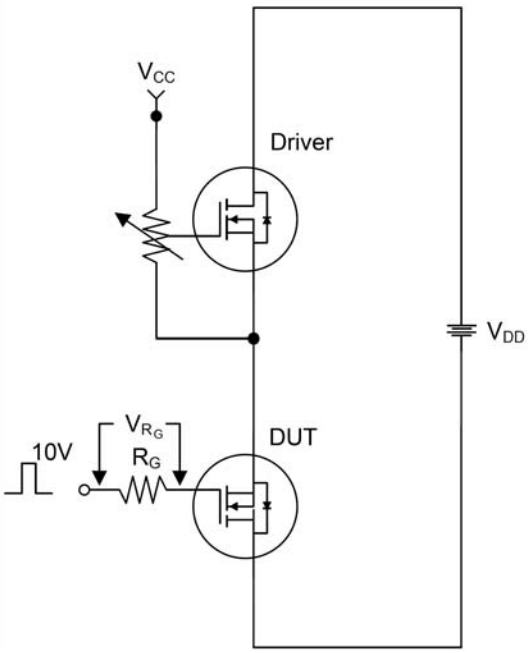


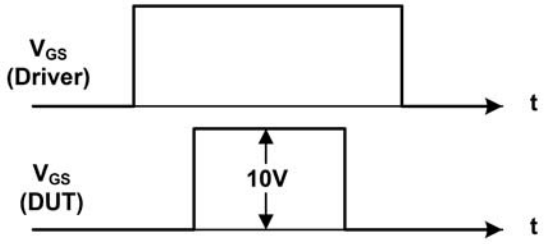
**Peak Diode Recovery dv/dt Test Circuit & Waveforms**



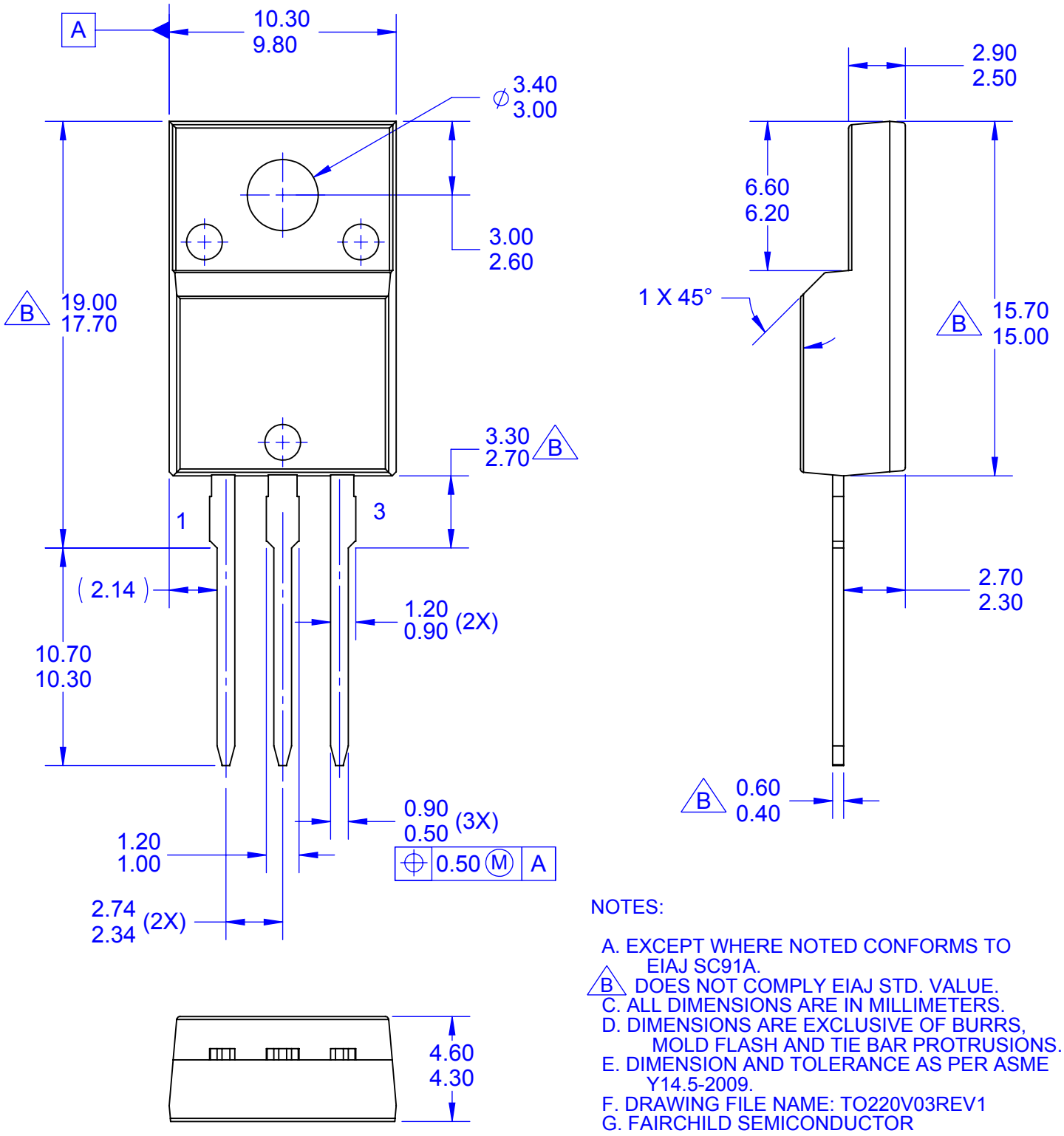



**Total Gate Charge Qsync. Test Circuit & Waveforms**




$$Qsync = \frac{1}{R_G} \cdot \int V_{R_G}(t)\ dt$$




NOTES:

A. EXCEPT WHERE NOTED CONFORMS TO EIAJ SC91A.
B DOES NOT COMPLY EIAJ STD. VALUE.
C. ALL DIMENSIONS ARE IN MILLIMETERS.
D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
E. DIMENSION AND TOLERANCE AS PER ASME Y14.5-2009.
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