FAIRCHILD SEMICONDUCTOR®

November 2013

# FDA20N50F

## N-Channel UniFET™ FRFET® MOSFET

**500 V, 22 A, 260 mΩ**

### Features

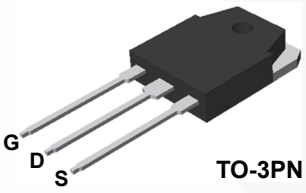
- $R_{DS(on)}$ = 220 mΩ (Typ.) @ $V_{GS}$ = 10 V, $I_D$ = 11 A
- Low Gate Charge (Typ. 50 nC)
- Low $C_{rss}$ (Typ. 27 pF)
- 100% Avalanche Tested
- Improved dv/dt Capability
- RoHS Compliant

### Applications

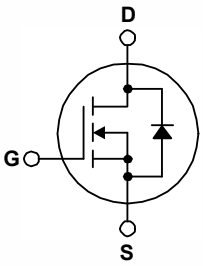
- PDP TV
- Uninterruptible Power Supply
- AC-DC Power Supply

### 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 trr 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-3PN




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

| Symbol | Parameter | | | FDA20N50F | 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°C) | | 22 | A |
| | | - Continuous ($T_C$ = 100°C) | | 13 | |
| $I_{DM}$ | Drain Current | - Pulsed | (Note 1) | 88 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy | | (Note 2) | 1110 | mJ |
| $I_{AR}$ | Avalanche Current | | (Note 1) | 22 | A |
| $E_{AR}$ | Repetitive Avalanche Energy | | (Note 1) | 39 | mJ |
| dv/dt | Peak Diode Recovery dv/dt | | (Note 3) | 20 | V/ns |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C) | | 388 | W |
| | | - Derate above 25°C | | 3.1 | W/°C |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | | -55 to +150 | °C |
| $T_L$ | Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds | | | 300 | °C |

## Thermal Characteristics

| Symbol | Parameter | FDA20N50F | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 0.44 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 40 | |

## Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FDA20N50F | FDA20N50F | TO-3PN | Tube | N/A | 30 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 | $I_D$ = 250μA, $V_{GS}$ = 0V, $T_J$ = 25°C | 500 | - | - | V |
| $\Delta BV_{DSS}$ / $\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250μA, Referenced to 25°C | - | 0.6 | - | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 500V, $V_{GS}$ = 0V | - | - | 10 | μA |
| | | $V_{DS}$ = 400V, $T_C$ = 125°C | - | - | 100 | |
| $I_{GSS}$ | Gate to Body Leakage Current | $V_{GS}$ = ±30V, $V_{DS}$ = 0V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250μA | 3.0 | - | 5.0 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 10V, $I_D$ = 11A | - | 0.22 | 0.26 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 40V, $I_D$ = 11A | - | 24 | - | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25V, $V_{GS}$ = 0V, f = 1MHz | - | 2550 | 3390 | pF |
| $C_{oss}$ | Output Capacitance | | - | 350 | 465 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 27 | 40 | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10V | $V_{DS}$ = 400V, $I_D$ = 20A, $V_{GS}$ = 10V (Note 4) | - | 50 | 65 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | - | 14 | - | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | - | 20 | - | nC |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 250V, $I_D$ = 20A, $R_G$ = 25Ω (Note 4) | - | 45 | 100 | ns |
| $t_r$ | Turn-On Rise Time | | - | 120 | 250 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 100 | 210 | ns |
| $t_f$ | Turn-Off Fall Time | | - | 60 | 130 | ns |
| **Drain-Source Diode Characteristics** | | | | | | |
| $I_S$ | Maximum Continuous Drain to Source Diode Forward Current | | - | - | 22 | A |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current | | - | - | 88 | A |
| $V_{SD}$ | Drain to Source Diode Forward Voltage | $V_{GS}$ = 0V, $I_{SD}$ = 22A | - | - | 1.5 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0V, $I_{SD}$ = 20A, $dI_F/dt$ = 100A/μs | - | 154 | - | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 0.5 | - | μC |

**Notes:**
1: Repetitive Rating: Pulse width limited by maximum junction temperature
2: L = 5mH, $I_{AS}$ = 20A, $V_{DD}$ = 50V, $R_G$ = 25Ω, Starting $T_J$ = 25°C
3: $I_{SD} \le$ 22A, di/dt ≤ 200A/μs, $V_{DD} \le BV_{DSS}$, Starting $T_J$ = 25°C
4: Essentially Independent of Operating Temperature Typical Characteristics

## Typical Characteristics

**Figure 1. On-Region Characteristics**

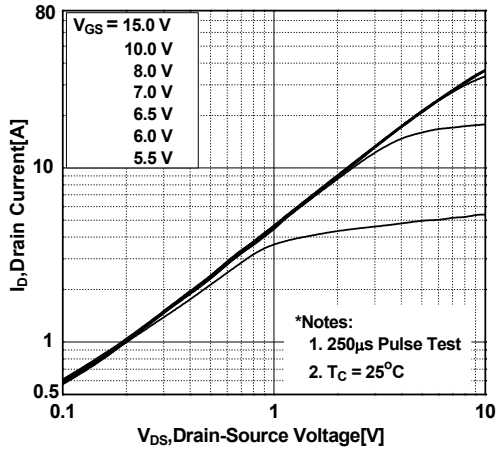



**Figure 2. Transfer Characteristics**

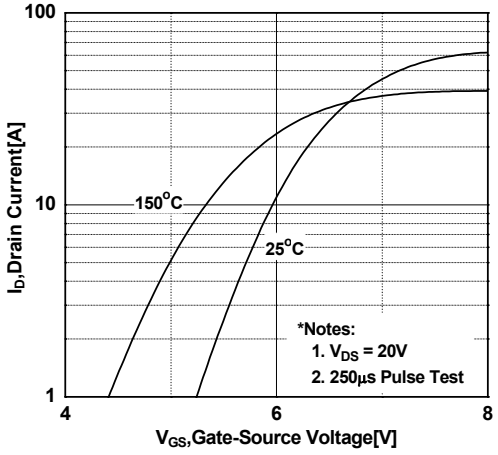



**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**

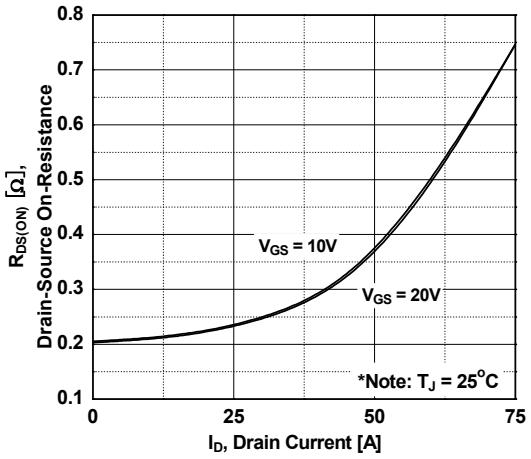



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

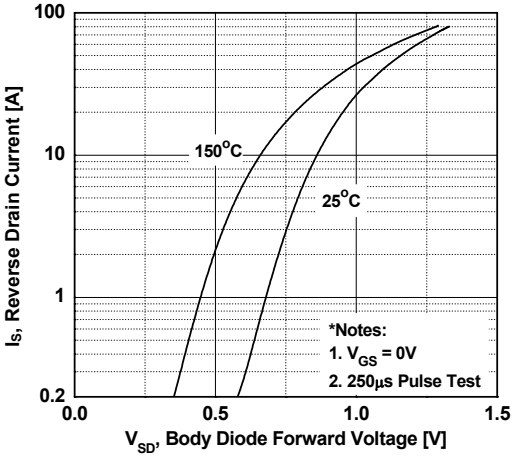



**Figure 5. Capacitance Characteristics**

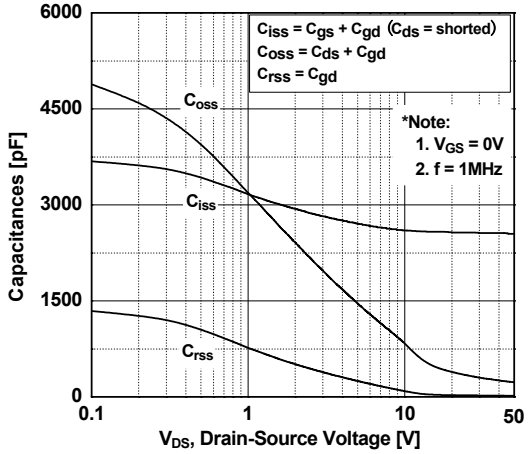
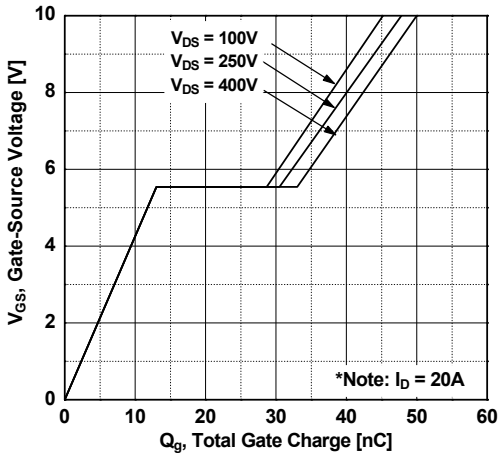



**Figure 6. Gate Charge Characteristics**



## Typical Characteristics (Continued)

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

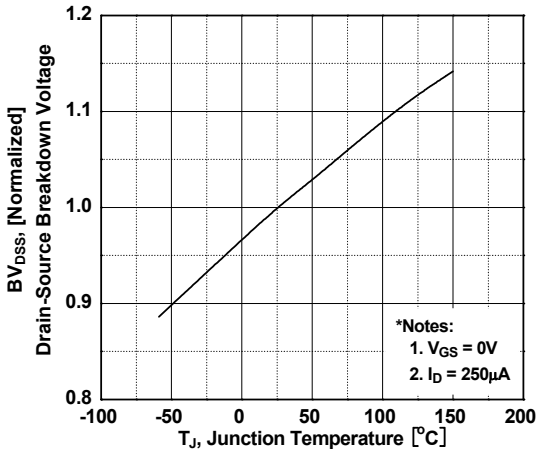



**Figure 8. Maximum Safe Operating Area**

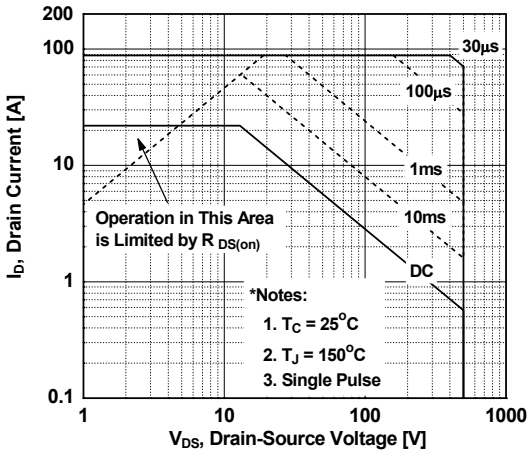



**Figure 9. Maximum Drain Current vs. Case Temperature**

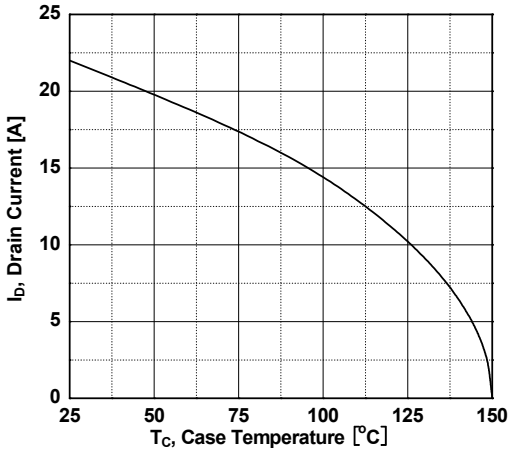



**Figure 10. Transient Thermal Response Curve**

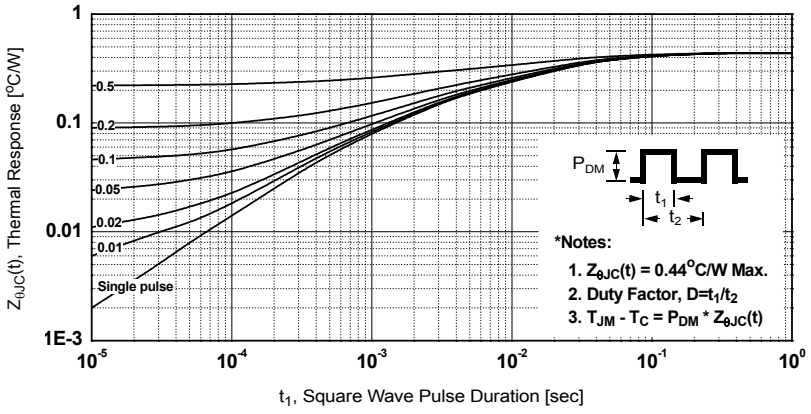


**Figure 11. Gate Charge Test Circuit & Waveform**

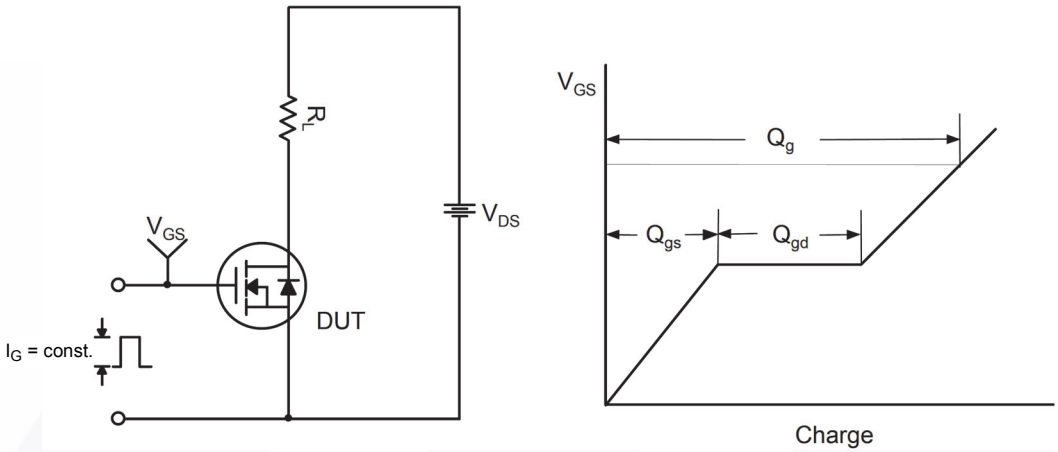



**Figure 12. Resistive Switching Test Circuit & Waveforms**

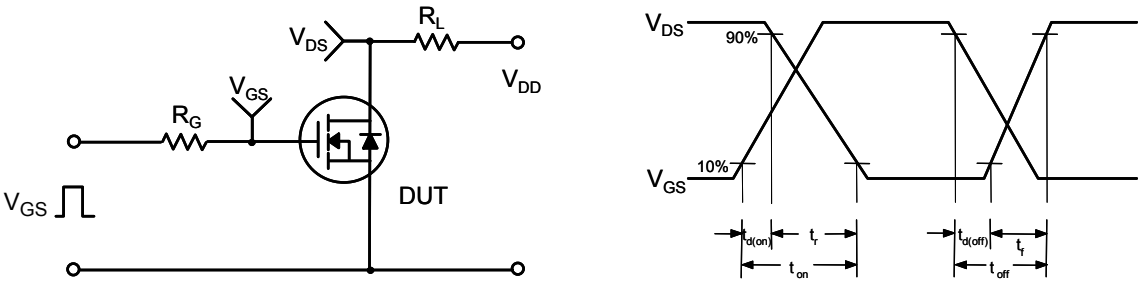



**Figure 13. Unclamped Inductive Switching Test Circuit & Waveforms**

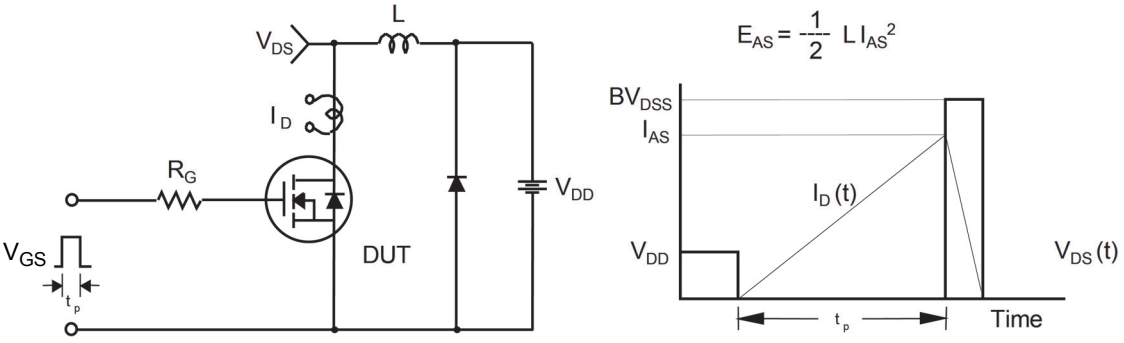
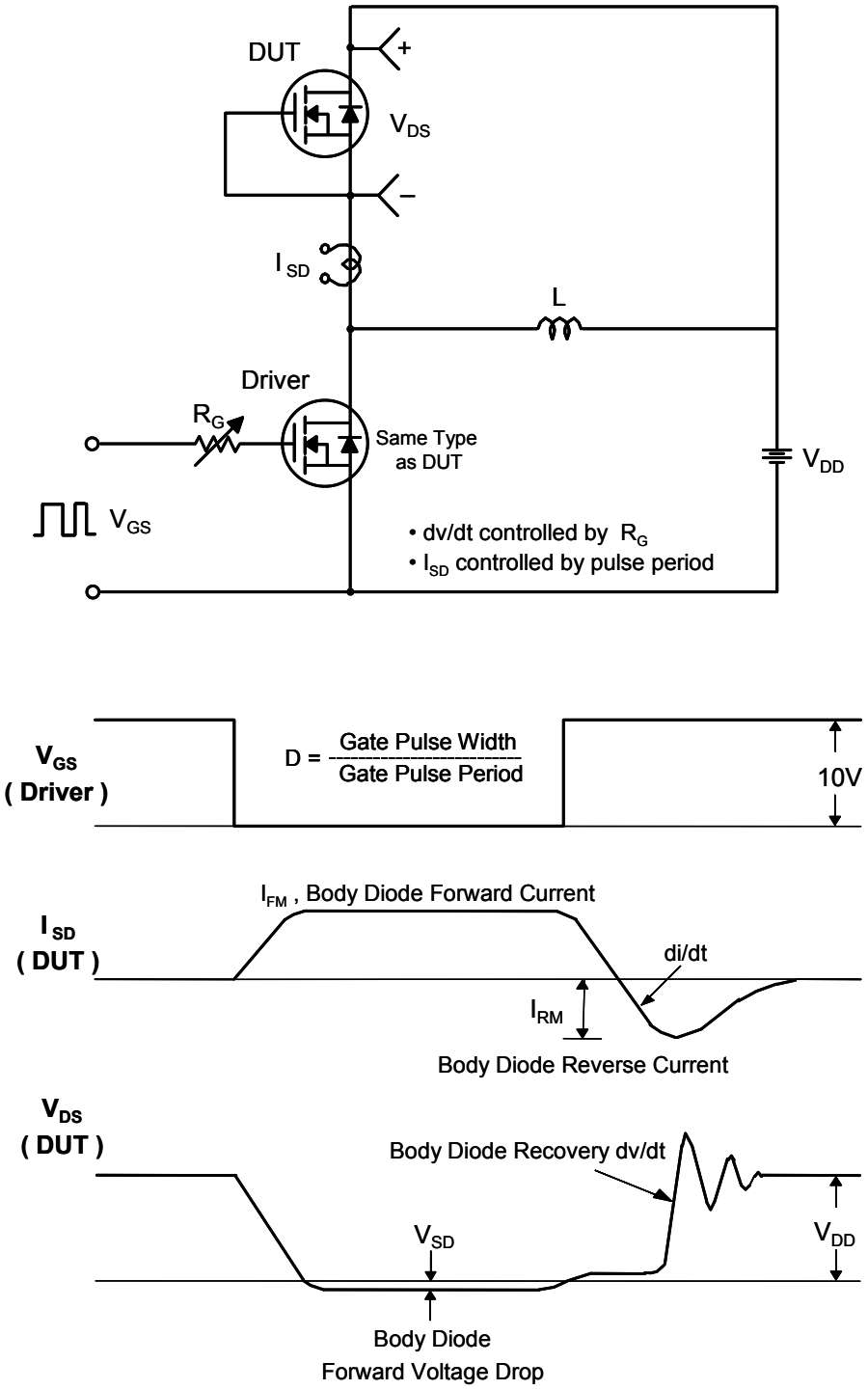


**Figure 14. Peak Diode Recovery dv/dt Test Circuit & Waveforms**



## Mechanical Dimensions

TO-3PN 3L

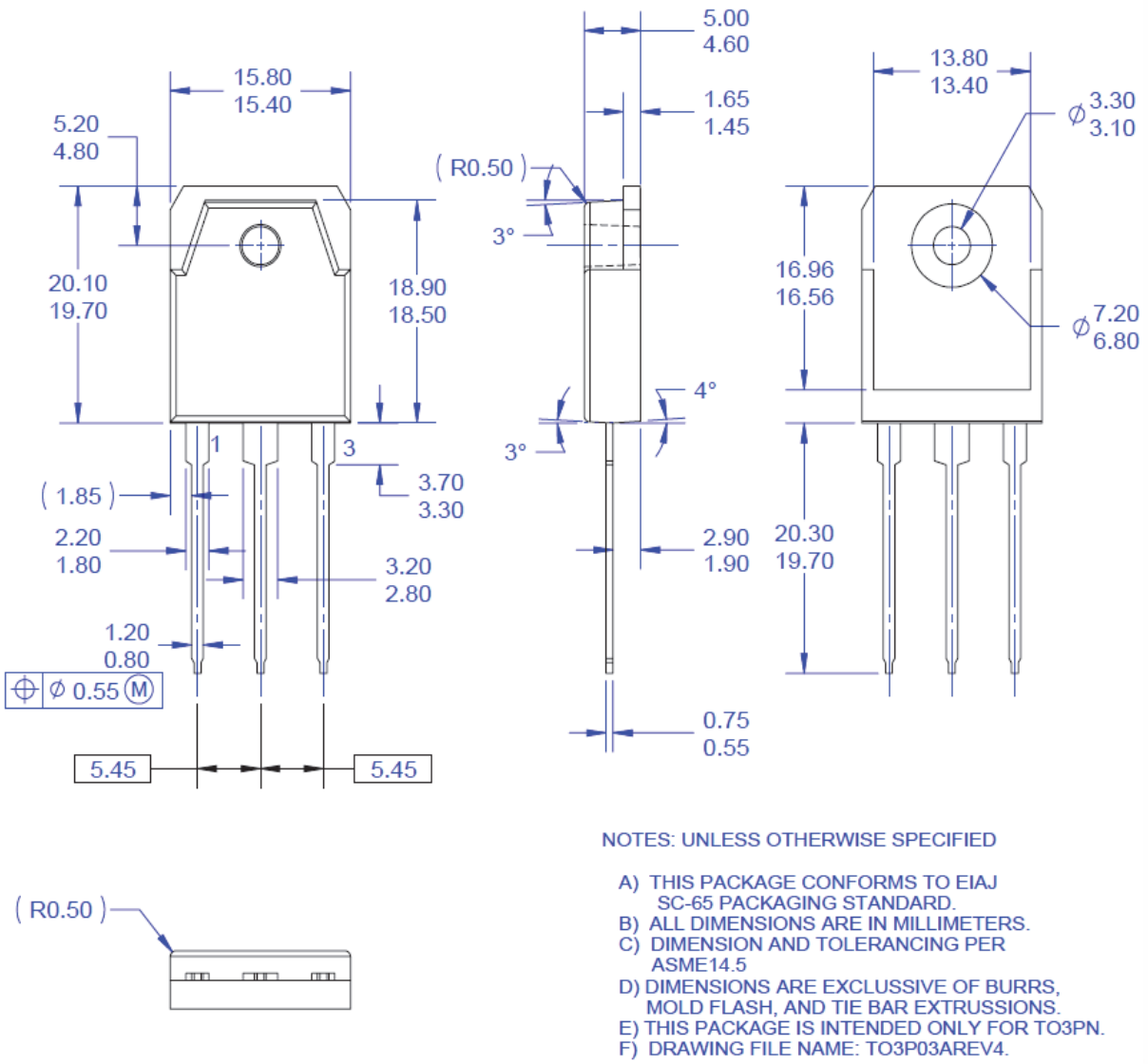



**Figure 15. 3LD, T03, Plastic, EIAJ SC-65**

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Dimension in Millimeters

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