FAIRCHILD SEMICONDUCTOR®

November 2013

# FDP24N40

## N-Channel UniFET™ MOSFET

**400 V, 24 A, 175 mΩ**

### Features

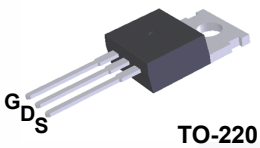
- $R_{DS(on)}$ = 140 mΩ (Typ.) @ $V_{GS}$ = 10 V, $I_D$ = 12 A
- Low Gate Charge (Typ. 46 nC)
- Low $C_{rss}$ (Typ. 25 pF)
- 100% Avalanche Tested
- RoHS Compliant

### Applications

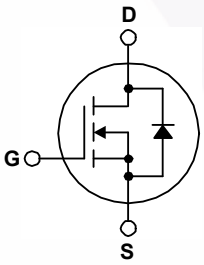
- Uninterruptible Power Supply
- AC-DC Power Supply

### 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. 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-220




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

| Symbol | Parameter | | | FDP24N40 | Unit |
|---|---|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage | | | 400 | V |
| $V_{GSS}$ | Gate to Source Voltage | | | ±30 | V |
| $I_D$ | Drain Current | - Continuous ($T_C$ = 25°C) | | 24 | A |
| | | - Continuous ($T_C$ = 100°C) | | 14.4 | |
| $I_{DM}$ | Drain Current | - Pulsed | (Note 1) | 96 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy | | (Note 2) | 1296 | mJ |
| $I_{AR}$ | Avalanche Current | | (Note 1) | 24 | A |
| $E_{AR}$ | Repetitive Avalanche Energy | | (Note 1) | 22.7 | mJ |
| dv/dt | Peak Diode Recovery dv/dt | | (Note 3) | 4.5 | V/ns |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C) | | 227 | W |
| | | - Derate Above 25°C | | 1.8 | 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 | FDP24N40 | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 0.55 | °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 |
|---|---|---|---|---|---|---|
| FDP24N40 | FDP24N40 | TO-220 | 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, $T_J = 25^oC$ | 400 | - | - | V |
| $\Delta BV_{DSS}$ / $\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to $25^oC$ | - | 0.4 | - | $V/^oC$ |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 400 V, $V_{GS}$ = 0 V | - | - | 1 | μA |
| | | $V_{DS}$ = 320 V, $T_C = 125^oC$ | - | - | 10 | |
| $I_{GSS}$ | Gate to Body Leakage Current | $V_{GS}$ = ±30 V, $V_{DS}$ = 0 V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | 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, $I_D$ = 12 A | - | 0.140 | 0.175 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 20 V, $I_D$ = 12 A | - | 34 | - | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1 MHz | - | 2270 | 3020 | pF |
| $C_{oss}$ | Output Capacitance | | - | 365 | 490 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 25 | 38 | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10V | $V_{DS}$ = 320 V, $I_D$ = 24 A, $V_{GS}$ = 10 V (Note 4) | - | 46 | 60 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | - | 12 | - | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | - | 20 | - | nC |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 200 V, $I_D$ = 24 A, $V_{GS}$ = 10 V, $R_G$ = 25 Ω (Note 4) | - | 40 | 90 | ns |
| $t_r$ | Turn-On Rise Time | | - | 90 | 190 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 110 | 230 | ns |
| $t_f$ | Turn-Off Fall Time | | - | 65 | 140 | ns |
| **Drain-Source Diode Characteristics** | | | | | | |
| $I_S$ | Maximum Continuous Drain to Source Diode Forward Current | | - | - | 24 | A |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current | | - | - | 96 | A |
| $V_{SD}$ | Drain to Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 24 A | - | - | 1.4 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_{SD}$ = 24 A, $dI_F/dt$ = 100 A/μs | - | 360 | - | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 4.7 | - | μC |

**Notes:**

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. L = 4.5 mH, $I_{AS}$ = 24 A, $V_{DD}$ = 50 V, $R_G$ = 25 Ω, starting $T_J = 25°C$.
3. $I_{SD} \le 24$ 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**

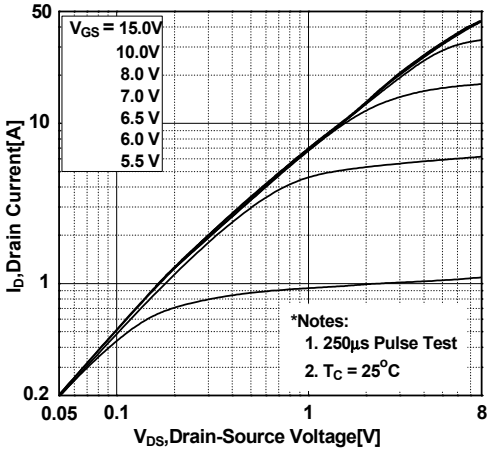



**Figure 2. Transfer Characteristics**

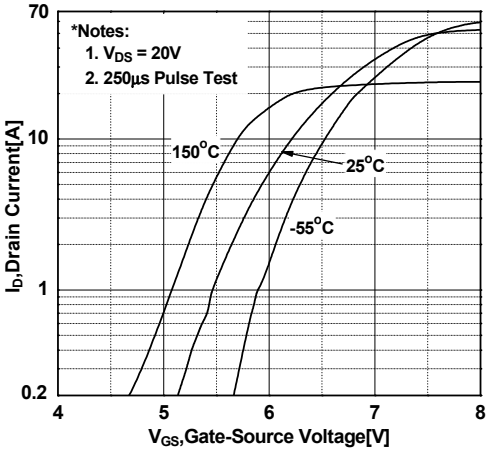



**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**

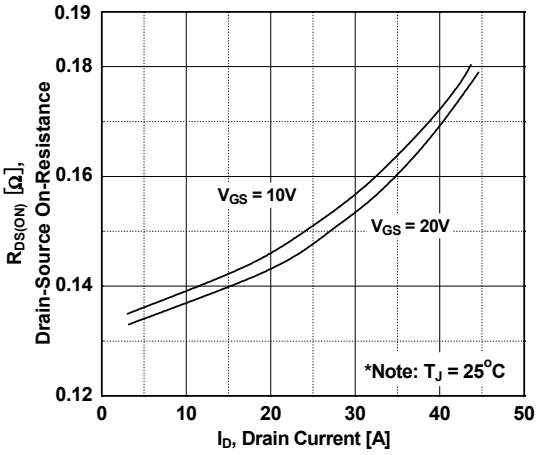



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

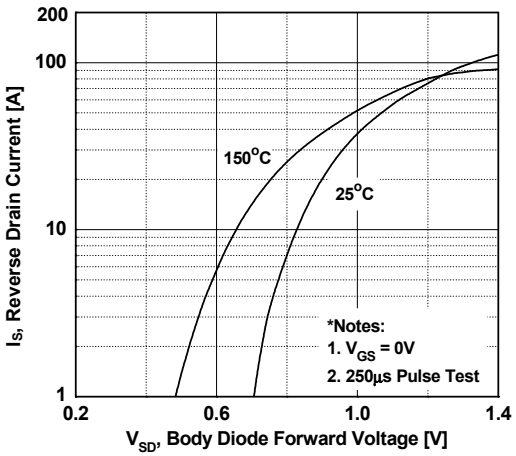



**Figure 5. Capacitance Characteristics**

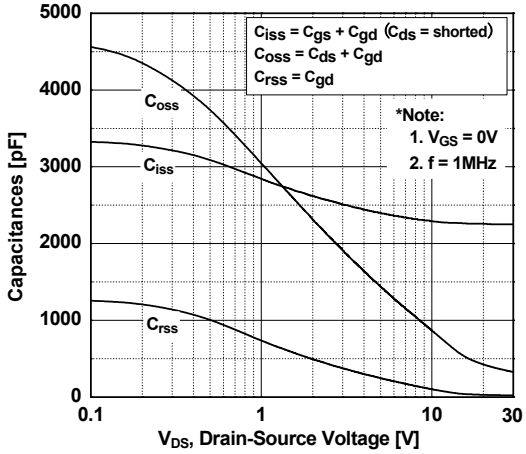
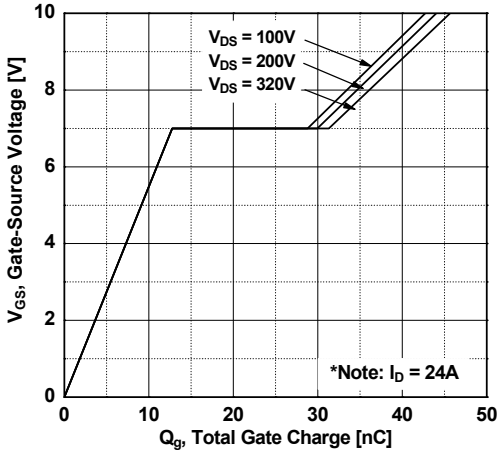



**Figure 6. Gate Charge Characteristics**



## Typical Performance Characteristics (Continued)

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

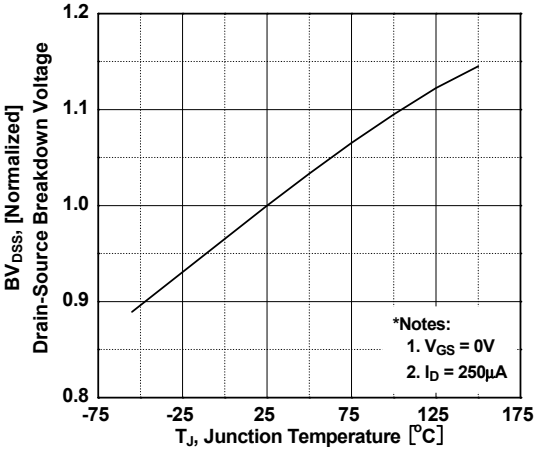



**Figure 8. On-Resistance Variation vs. Temperature**

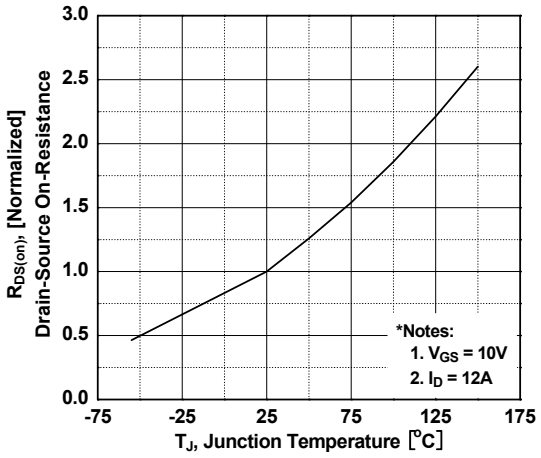



**Figure 9. Maximum Safe Operating Area**

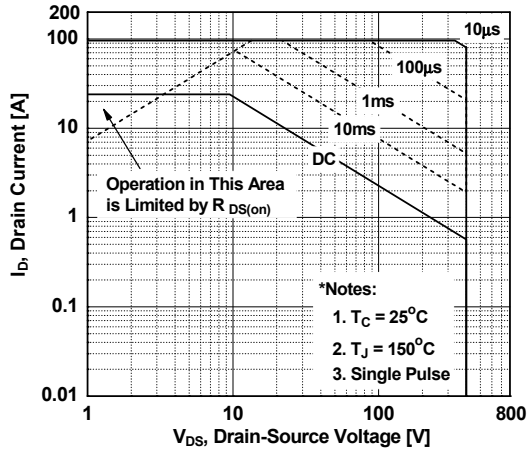



**Figure 10. Maximum Drain Current vs. Case Temperature**

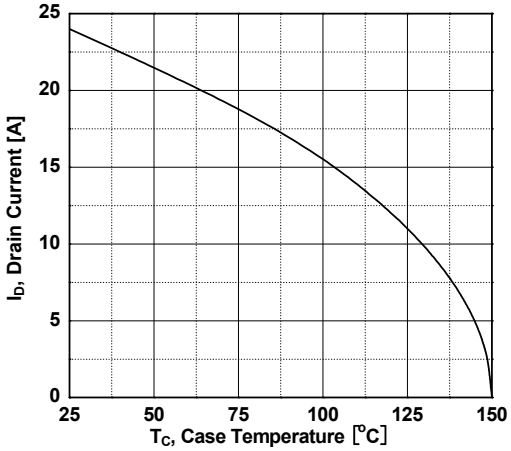
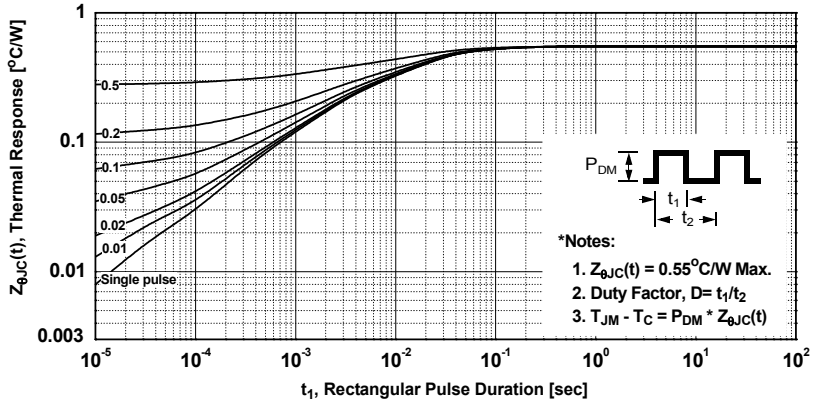



**Figure 11. Transient Thermal Response Curve**



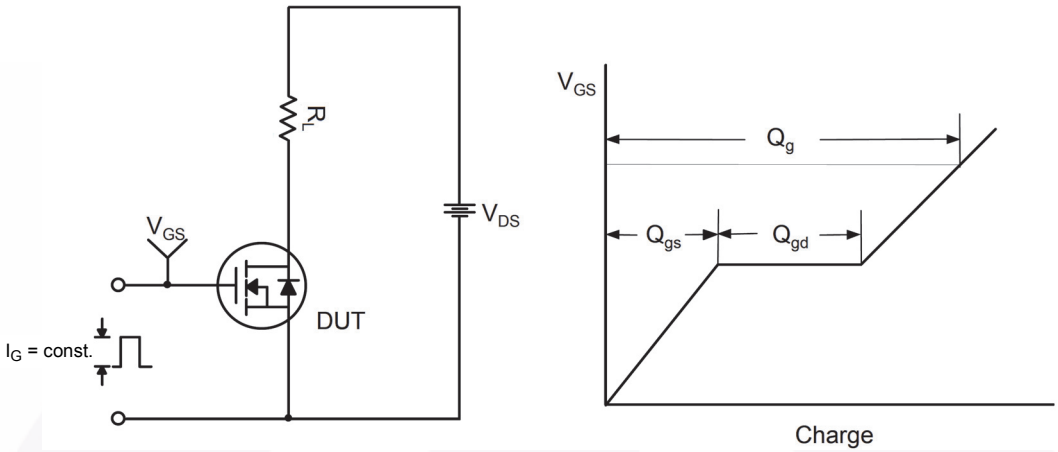



**Figure 12. Gate Charge Test Circuit & Waveform**

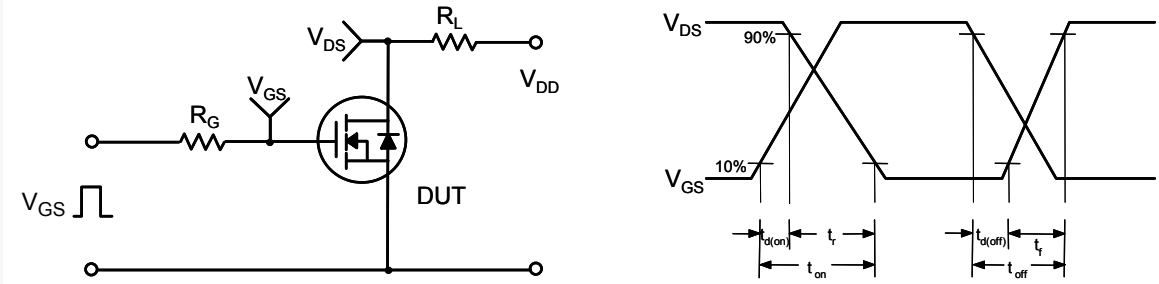



**Figure 13. Resistive Switching Test Circuit & Waveforms**

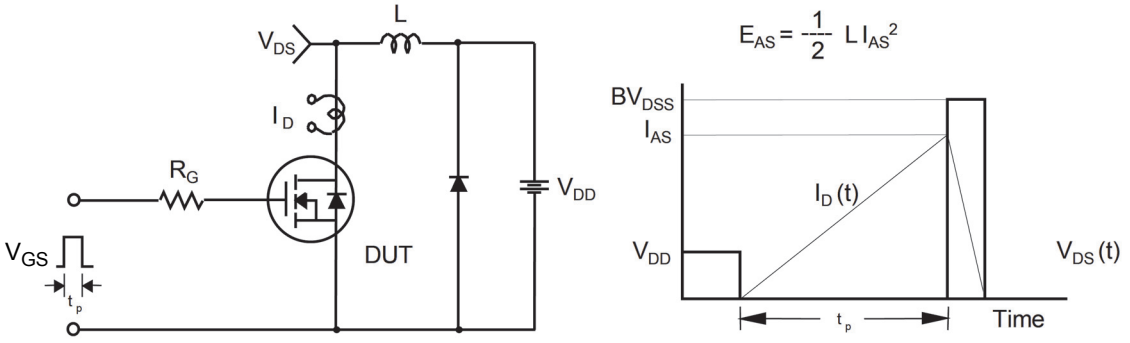



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

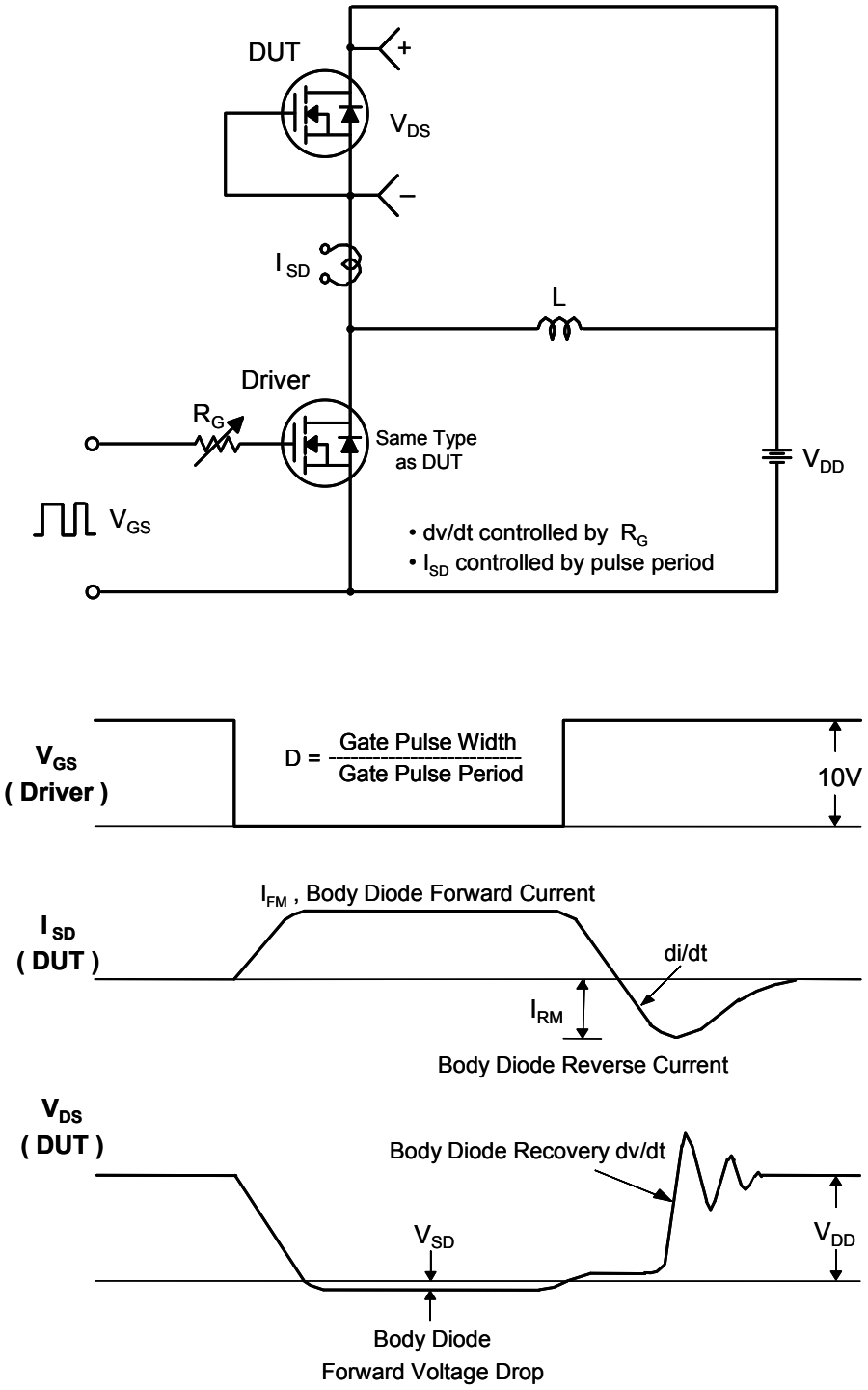



**Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms**

## Mechanical Dimensions

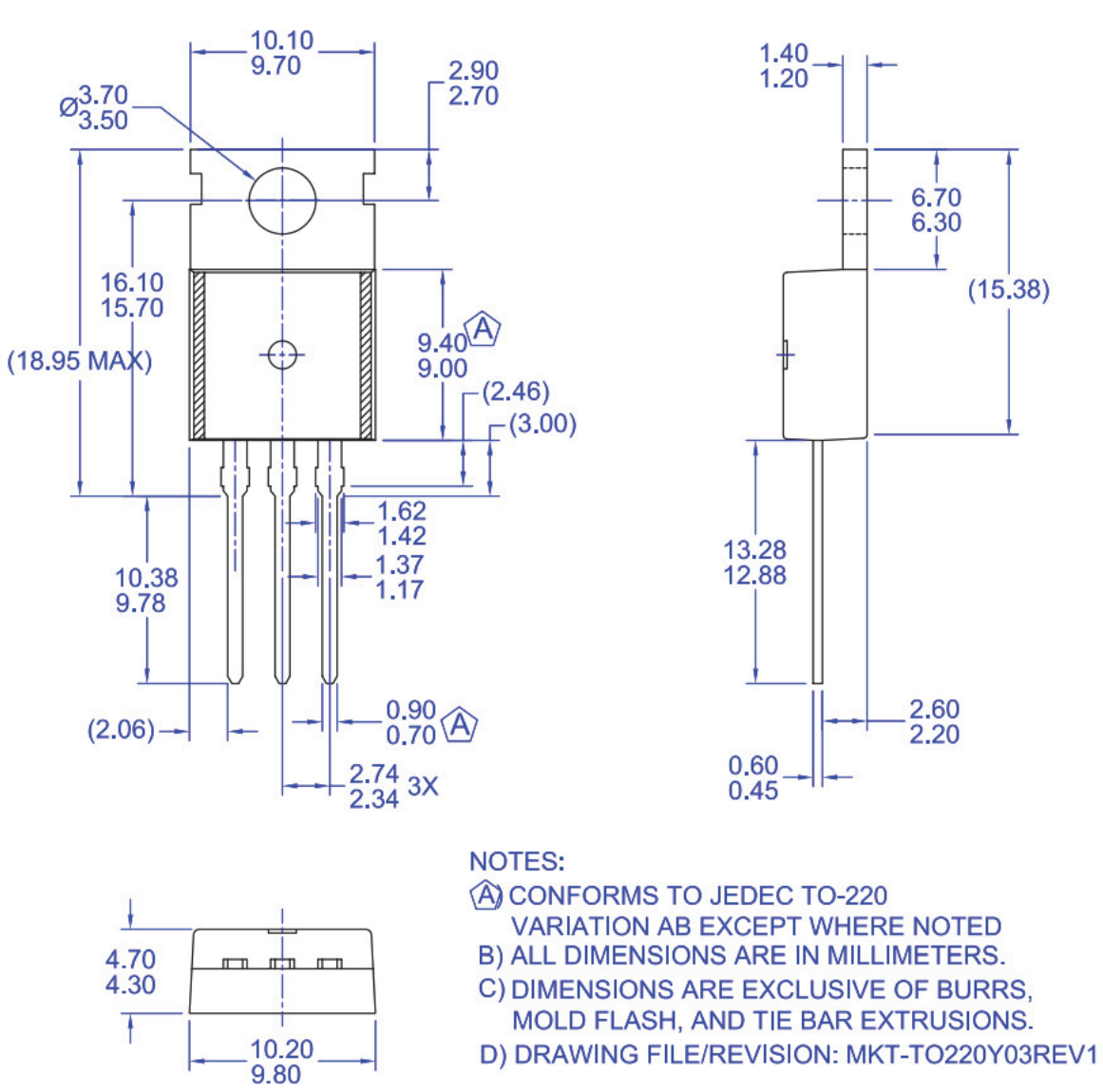



**Figure 16. TO220, Molded, 3-Lead, Jedec Variation AB**

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