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June 2014

# FDB024N04AL7

## N-Channel PowerTrench® MOSFET

**40 V, 219 A, 2.4 mΩ**

## Features

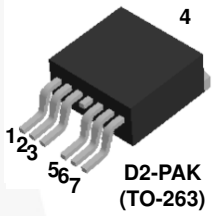
- $R_{DS(on)}$ = 2.0 mΩ (Typ.)@ $V_{GS}$ = 10 V, $I_D$ = 80 A
- Fast Switching Speed
- Low Gate Charge
- High Performance Trench Technology for Extremely Low $R_{DS(on)}$
- High Power and Current Handling Capability
- RoHS Compliant

## Description

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

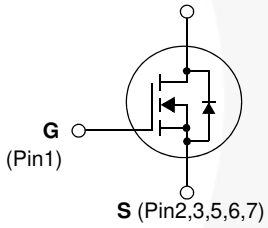
## Applications

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




D2-PAK
(TO-263)

1. Gate
2. Source
3. Source
4. Drain
5. Source
6. Source
7. Source




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

| Symbol | Parameter | | FDB024N04AL7 | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage | | 40 | V |
| $V_{GSS}$ | Gate to Source Voltage | | ±20 | V |
| $I_D$ | Drain Current | - Continuous ($T_C$ = 25°C, Silicon Limited) | 219* | A |
| | | - Continuous ($T_C$ = 100°C, Silicon Limited) | 155* | |
| | | - Continuous ($T_C$ = 25°C, Package Limited) | 100 | |
| $I_{DM}$ | Drain Current | - Pulsed (Note 1) | 876 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy | (Note 2) | 864 | mJ |
| dv/dt | Peak Diode Recovery dv/dt | (Note 3) | 6.0 | V/ns |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C) | 214 | W |
| | | - Derate Above 25°C | 1.43 | W/°C |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | -55 to +175 | °C |
| $T_L$ | Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds | | 300 | °C |

*Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 100 A.

## Thermal Characteristics

| Symbol | Parameter | FDB024N04AL7 | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 0.7 | °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 |
|---|---|---|---|---|---|---|
| FDB024N04AL7 | FDB024N04A | D2PAK-7L | Tape and Reel | 330 mm | 24 mm | 800 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, $T_C$ = 25°C | 40 | - | - | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | - | 30 | - | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 32 V, $V_{GS}$ = 0 V | - | - | 10 | μA |
| | | $V_{DS}$ = 32 V, $T_C$ = 150°C | - | - | 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 | 1.0 | - | 3.0 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 10 V, $I_D$ = 80 A | - | 2.0 | 2.4 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 10 V, $I_D$ = 80 A | - | 368 | - | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1 MHz | - | 5490 | 7300 | pF |
| $C_{oss}$ | Output Capacitance | | - | 1220 | 1620 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 155 | 233 | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10V | $V_{DS}$ = 32 V, $I_D$ = 80 A, $V_{GS}$ = 10 V (Note 4) | - | 84 | 109 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | - | 19 | - | nC |
| $Q_{gs2}$ | Gate Charge Threshold to Plateau | | - | 9.5 | - | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | - | 12 | - | nC |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 20 V, $I_D$ = 80 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V (Note 4) | - | 17 | 44 | ns |
| $t_r$ | Turn-On Rise Time | | - | 8 | 26 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 71 | 152 | ns |
| $t_f$ | Turn-Off Fall Time | | - | 17 | 44 | ns |
| ESR | Equivalent Series Resistance (G-S) | f = 1 MHz | - | 1.1 | - | Ω |
| **Drain-Source Diode Characteristics** | | | | | | |
| $I_S$ | Maximum Continuous Drain to Source Diode Forward Current | | - | - | 219 | A |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current | | - | - | 876 | A |
| $V_{SD}$ | Drain to Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 80 A | - | - | 1.3 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_{SD}$ = 80 A, $dI_F/dt$ = 100 A/μs | - | 54 | - | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 49 | - | nC |

**Notes:**

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. L = 3 mH, $I_{AS}$ = 24 A, $V_{DD}$ = 40 V, $R_G$ = 25 Ω, starting $T_J$ = 25°C.
3. $I_{SD}$ ≤ 80 A, di/dt ≤ 200 A/μs, $V_{DD}$ ≤ $BV_{DSS}$, starting $T_J$ = 25°C.
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

**Figure 1. On-Region Characteristics**

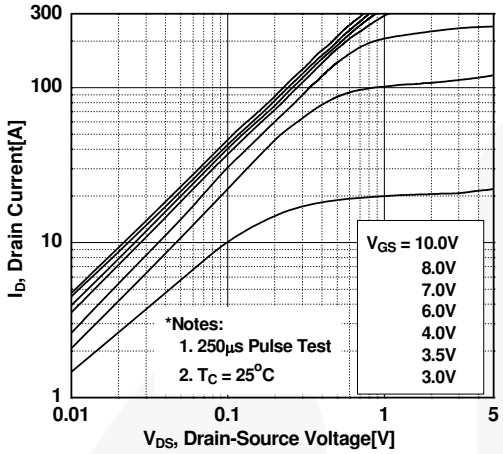



**Figure 2. Transfer Characteristics**

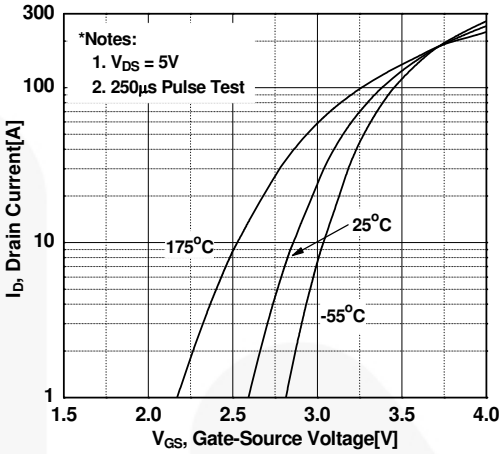



**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**

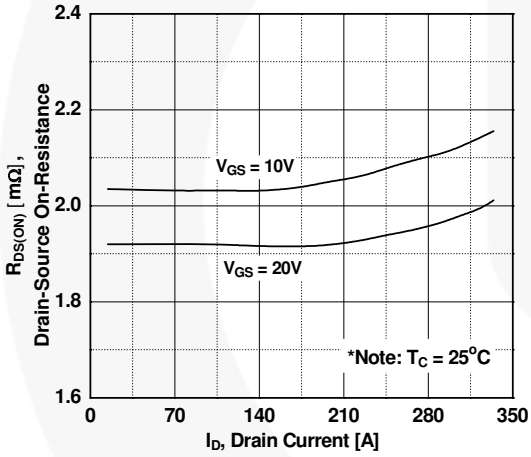



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

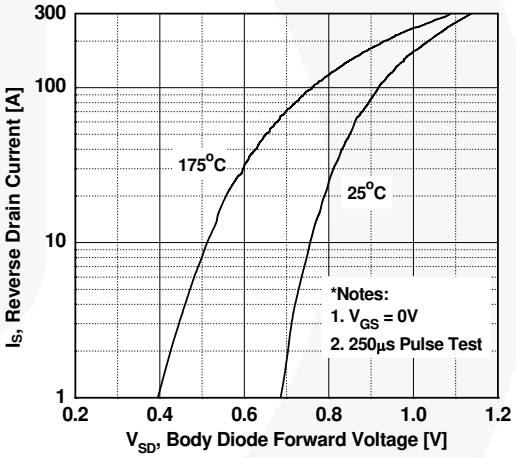



**Figure 5. Capacitance Characteristics**

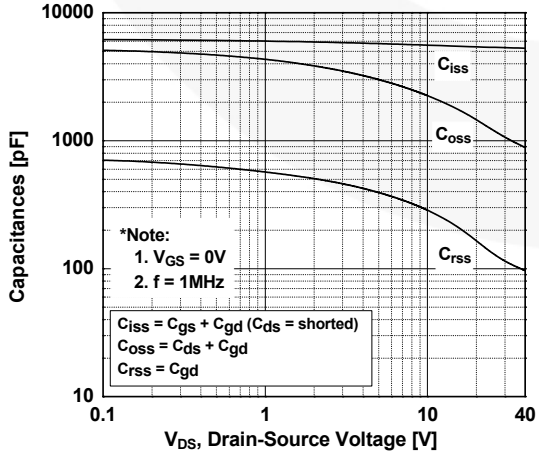
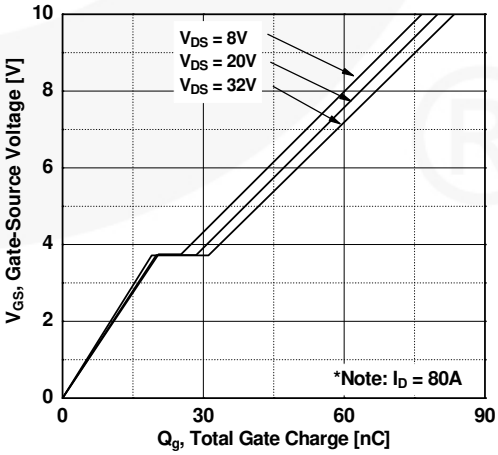



**Figure 6. Gate Charge Characteristics**



## Typical Performance Characteristics (Continued)

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

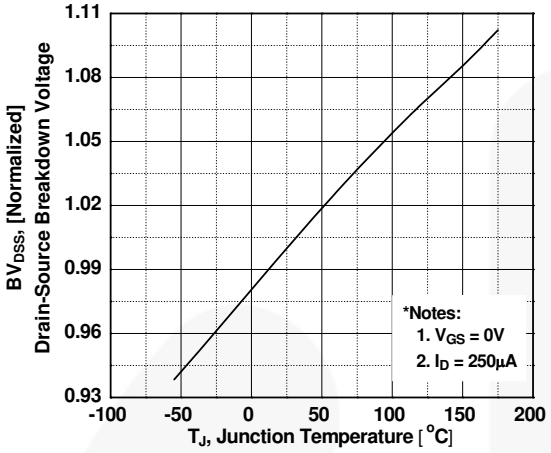



**Figure 8. On-Resistance Variation vs. Temperature**

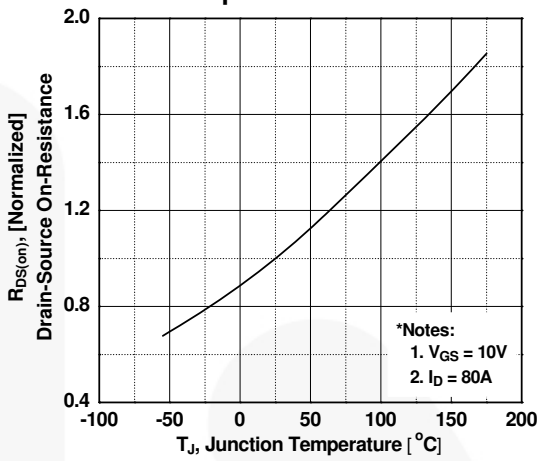



**Figure 9. Maximum Safe Operating Area**

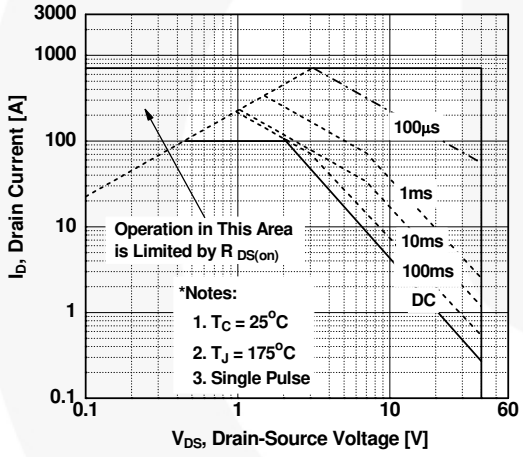



**Figure 10. Maximum Drain Current vs. Case Temperature**

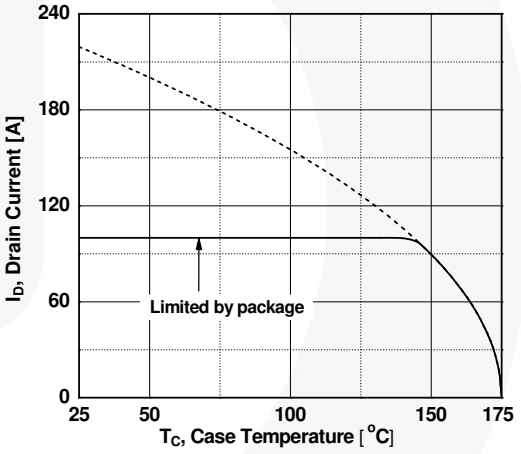
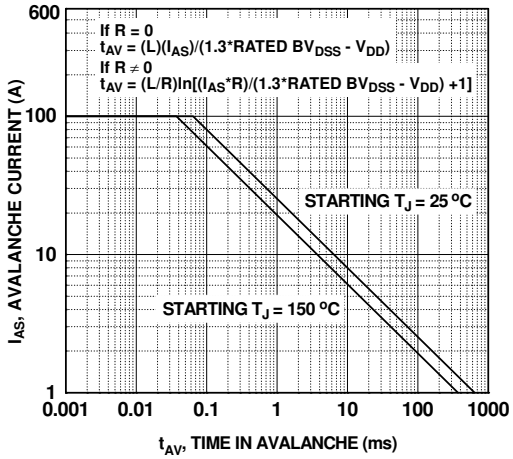



**Figure 11. Unclamped Inductive Switching Capability**



## Typical Performance Characteristics (Continued)

**Figure 12. Transient Thermal Response Curve**

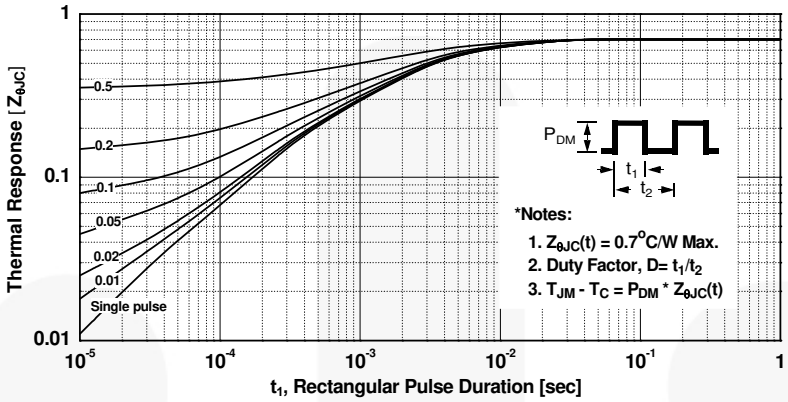


**Figure 13. Gate Charge Test Circuit & Waveform**

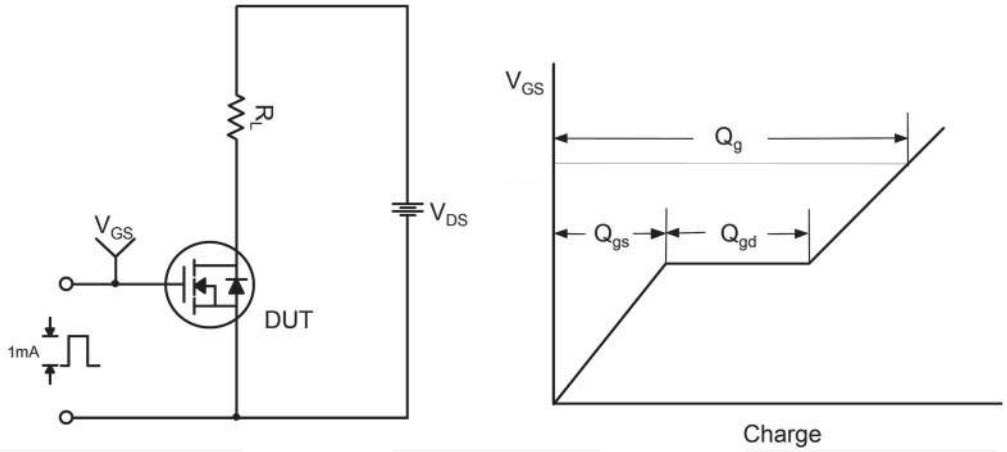



**Figure 14. Resistive Switching Test Circuit & Waveforms**

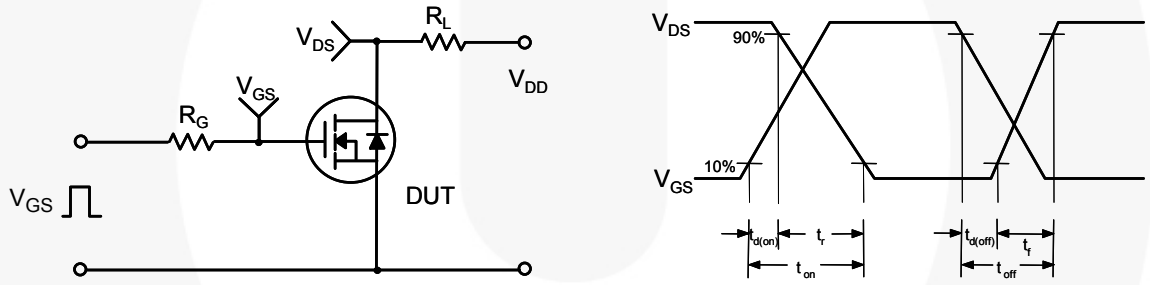



**Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms**

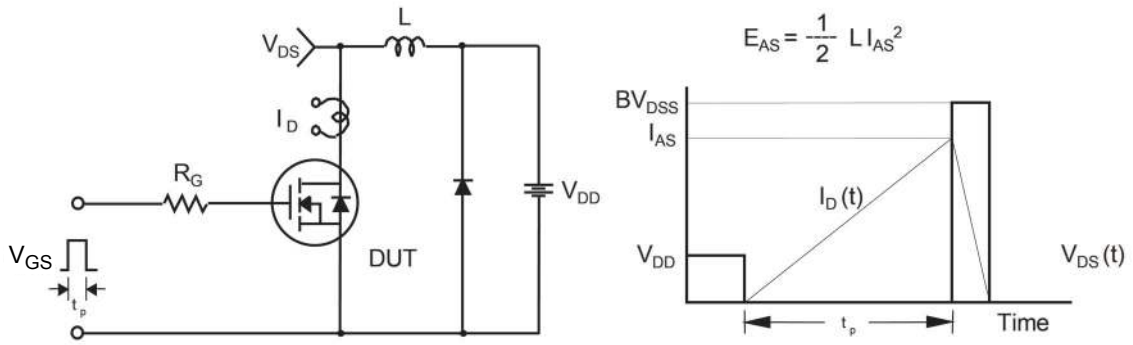
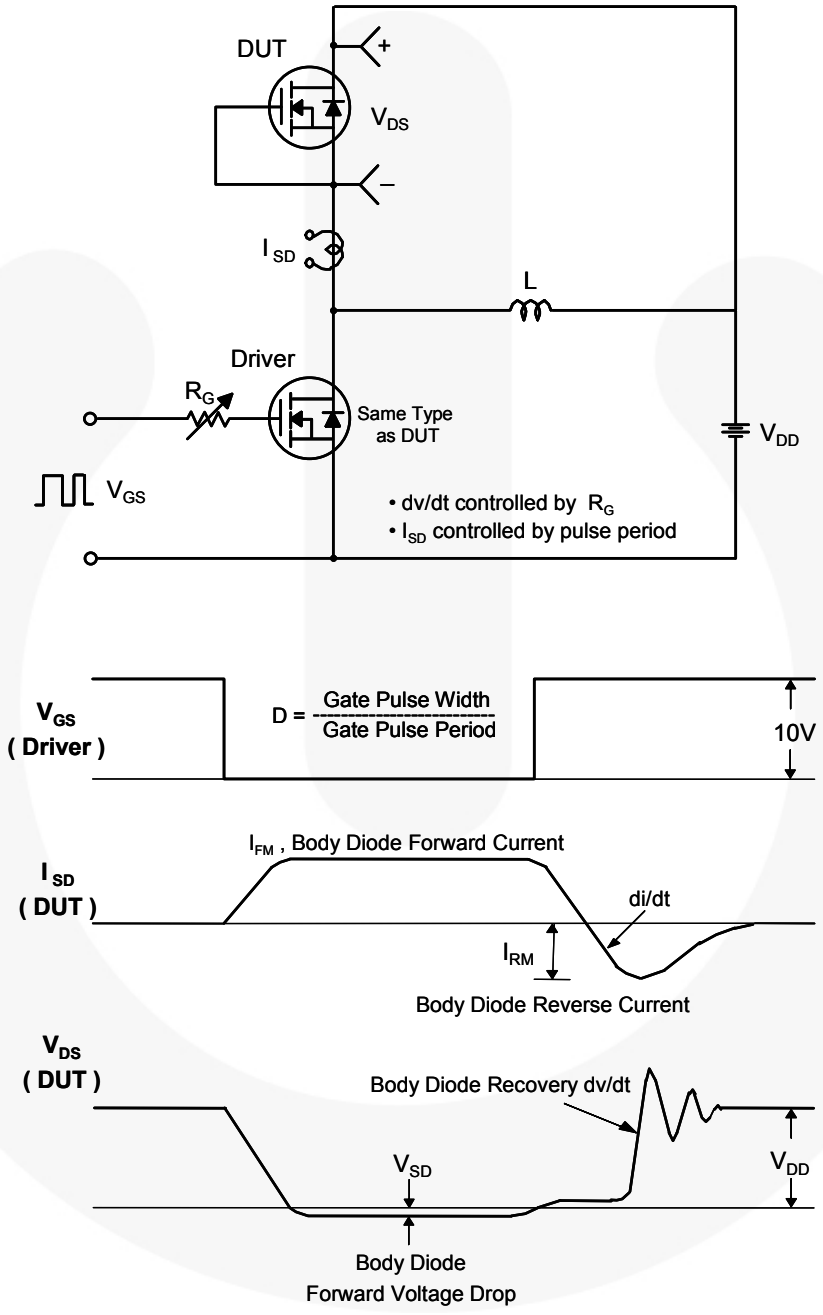


**Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms**



## Mechanical Dimensions

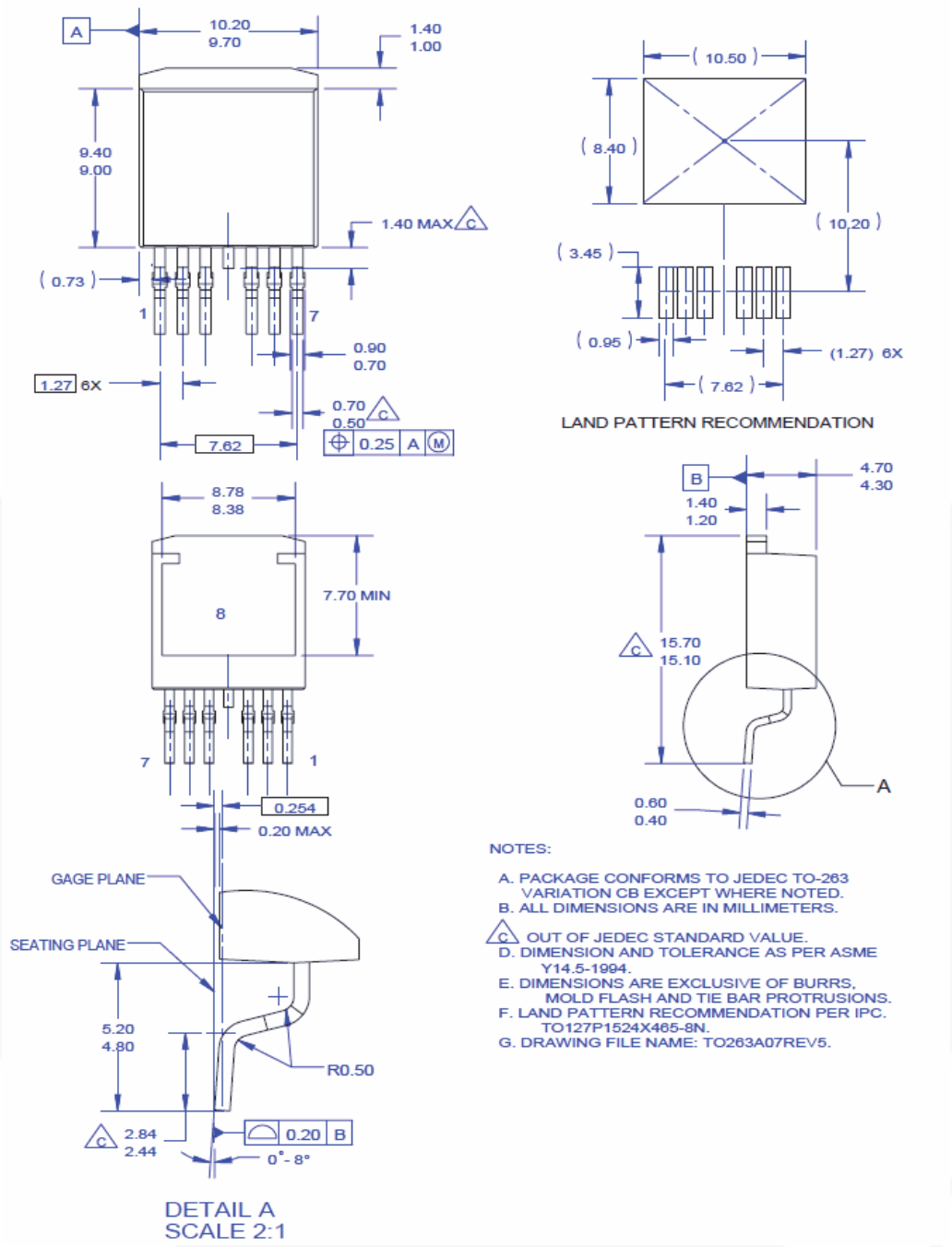



**Figure 17. TO263 ($D^2PAK$), Molded, 7-Lead, Surface Mount**

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