

# FDB024N04AL7

## N-Channel PowerTrench® MOSFET

40V, 219A, 2.4mΩ

### Features

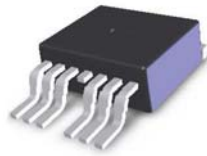
- $R_{DS(on)} = 2.0m\Omega$  (Typ.)@  $V_{GS} = 10V, I_D = 80A$
- Fast Switching Speed
- Low Gate Charge
- High Performance Trench Technology for Extremely Low  $R_{DS(on)}$
- High Power and Current Handling Capability
- RoHS Compliant

### Description

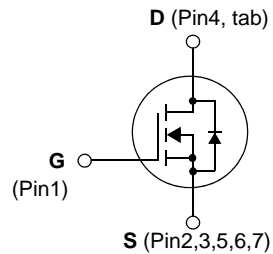
This N-Channel MOSFET is produced using Fairchild Semiconductor's advanced PowerTrench process that has been especially tailored to minimize the on-state resistance and yet maintain superior switching performance.

### Application

- DC to DC Convertors / Synchronous Rectification



**D<sup>2</sup>-PAK-7L**  
FDB Series with suffix -L7



### MOSFET Maximum Ratings $T_C = 25^\circ C$ unless otherwise noted\*

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

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

### Thermal Characteristics

| Symbol          | Parameter                               | Ratings | Units        |
|-----------------|---|---------|--------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case    | 0.7     | $^\circ C/W$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 62.5    |              |

## Package Marking and Ordering Information

| Device Marking | Device       | Package   | Reel Size | Tape Width | Quantity |
|----------------|--------------|-----------|-----------|------------|----------|
| FDB024N04A     | FDB024N04AL7 | D2-PAK-7L | 330mm     | 24mm       | 800      |

## Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|--------|-----------|-----------------|------|------|------|-------|
|--------|-----------|-----------------|------|------|------|-------|

### Off Characteristics

|                                      |   |  |    |    |           |                            |
|--------------------------------------|---|--|----|----|-----------|----------------------------|
| $BV_{DSS}$                           | Drain to Source Breakdown Voltage         | $I_D = 250\mu\text{A}$ , $V_{GS} = 0\text{V}$ , $T_C = 25^\circ\text{C}$ | 40 | -  | -         | V                          |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\mu\text{A}$ , Referenced to $25^\circ\text{C}$                | -  | 30 | -         | $\text{mV}/^\circ\text{C}$ |
| $I_{DSS}$                            | Zero Gate Voltage Drain Current           | $V_{DS} = 32\text{V}$ , $V_{GS} = 0\text{V}$                             | -  | -  | 10        | $\mu\text{A}$              |
|                                      |   | $V_{DS} = 32\text{V}$ , $T_C = 150^\circ\text{C}$                        | -  | -  | 500       |                            |
| $I_{GSS}$                            | Gate to Body Leakage Current              | $V_{GS} = \pm 20\text{V}$ , $V_{DS} = 0\text{V}$                         | -  | -  | $\pm 100$ | nA                         |

### On Characteristics

|              |                                      |   |     |     |     |                  |
|--------------|--------------------------------------|---|-----|-----|-----|------------------|
| $V_{GS(th)}$ | Gate Threshold Voltage               | $V_{GS} = V_{DS}$ , $I_D = 250\mu\text{A}$          | 1.0 | -   | 3.0 | V                |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{V}$ , $I_D = 80\text{A}$          | -   | 2.0 | 2.4 | $\text{m}\Omega$ |
| $g_{FS}$     | Forward Transconductance             | $V_{DS} = 10\text{V}$ , $I_D = 80\text{A}$ (Note 4) | -   | 368 | -   | S                |

### Dynamic Characteristics

|              |                                  |  |   |      |      |    |
|--------------|----------------------------------|--|---|------|------|----|
| $C_{iss}$    | Input Capacitance                | $V_{DS} = 25\text{V}$ , $V_{GS} = 0\text{V}$<br>$f = 1\text{MHz}$                  | - | 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         | $V_{DS} = 32\text{V}$ , $I_D = 80\text{A}$<br>$V_{GS} = 10\text{V}$<br>(Note 4, 5) | - | 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                 | $V_{DD} = 20\text{V}$ , $I_D = 80\text{A}$<br>$R_{GEN} = 4.7\Omega$ , $V_{GS} = 10\text{V}$<br>(Note 4, 5) | - | 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) |  | - | 1.1 | -   | $\Omega$ |

### Drain-Source Diode Characteristics

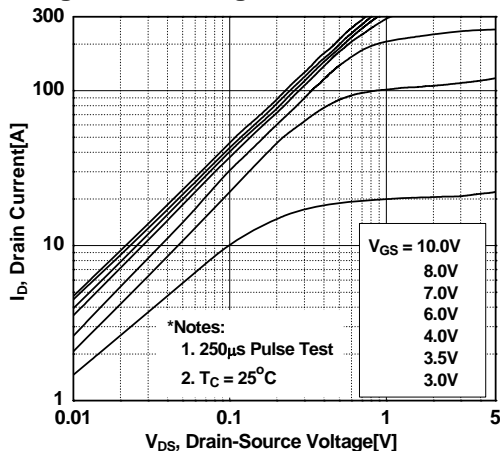
|          |  |  |   |     |     |    |
|----------|--|--|---|-----|-----|----|
| $I_S$    | Maximum Continuous Drain to Source Diode Forward Current | -  | - | 219 | A   |    |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current     | -  | - | 876 | A   |    |
| $V_{SD}$ | Drain to Source Diode Forward Voltage                    | $V_{GS} = 0\text{V}$ , $I_{SD} = 80\text{A}$ | - | -   | 1.3 | V  |
| $t_{rr}$ | Reverse Recovery Time                                    | $V_{GS} = 0\text{V}$ , $I_{SD} = 80\text{A}$ | - | 54  | -   | ns |
| $Q_{rr}$ | Reverse Recovery Charge                                  | $di_F/dt = 100\text{A}/\mu\text{s}$ (Note 4) | - | 49  | -   | nC |

#### Notes:

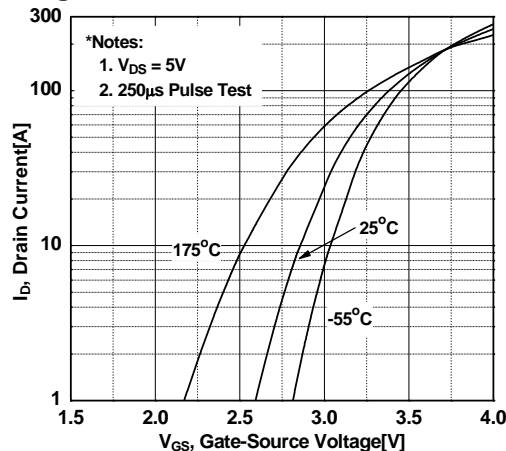
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L = 3\text{mH}$ ,  $I_{AS} = 24\text{A}$ ,  $V_{DD} = 40\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 80\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Pulse Test: Pulse width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$
5. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

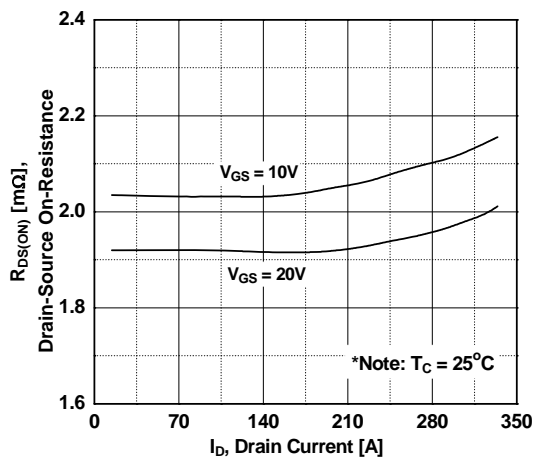
**Figure 1. On-Region Characteristics**



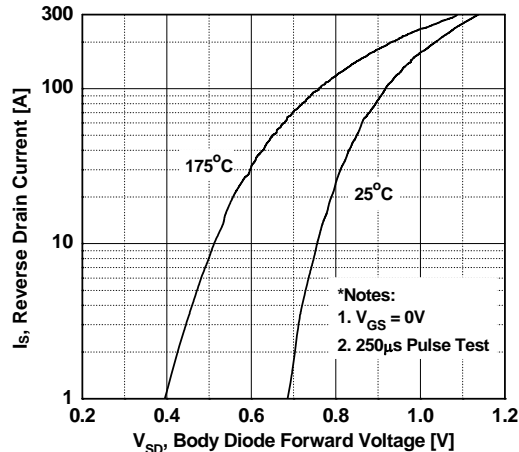
**Figure 2. Transfer Characteristics**



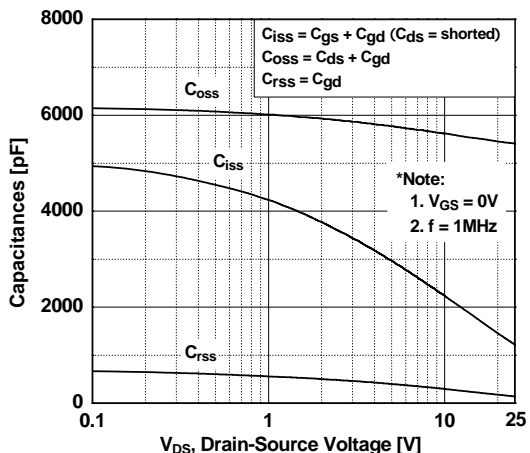
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



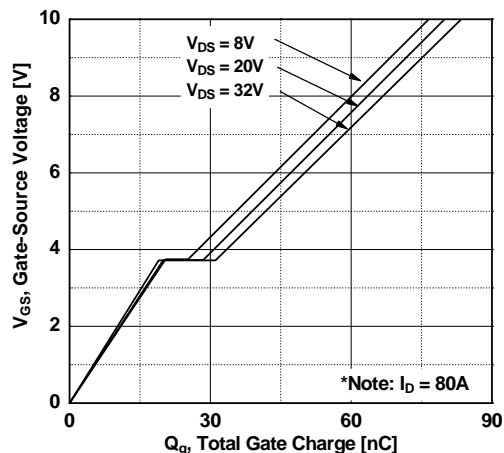
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

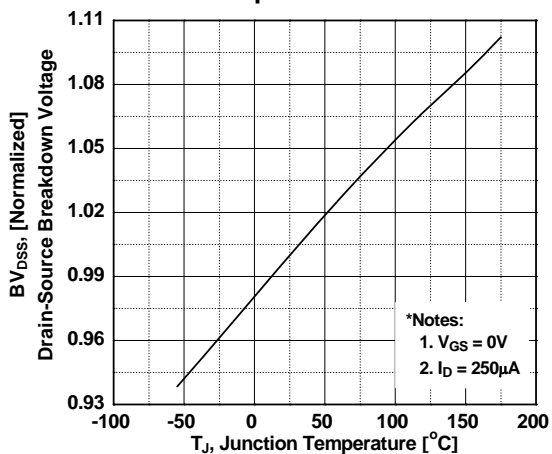


**Figure 6. Gate Charge Characteristics**

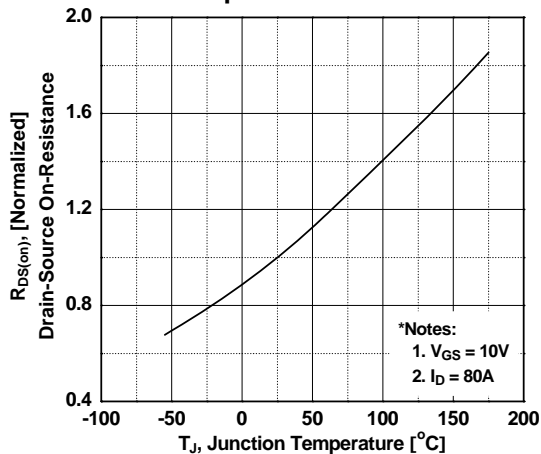


## Typical Performance Characteristics (Continued)

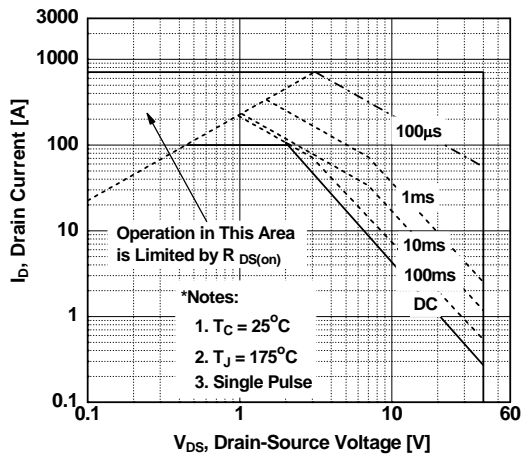
**Figure 7. Breakdown Voltage Variation vs. Temperature**



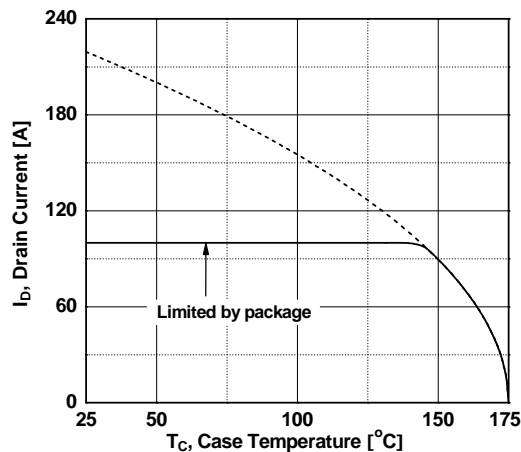
**Figure 8. On-Resistance Variation vs. Temperature**



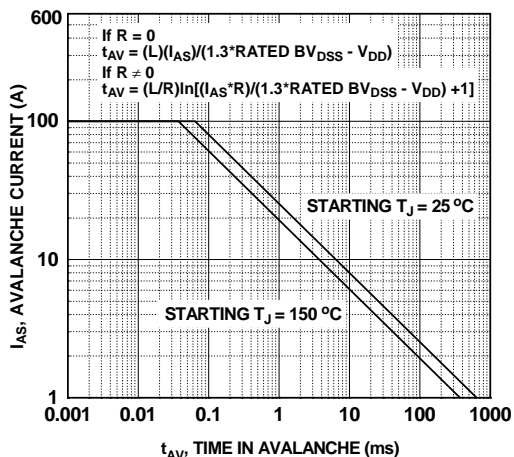
**Figure 9. Maximum Safe Operating Area**



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

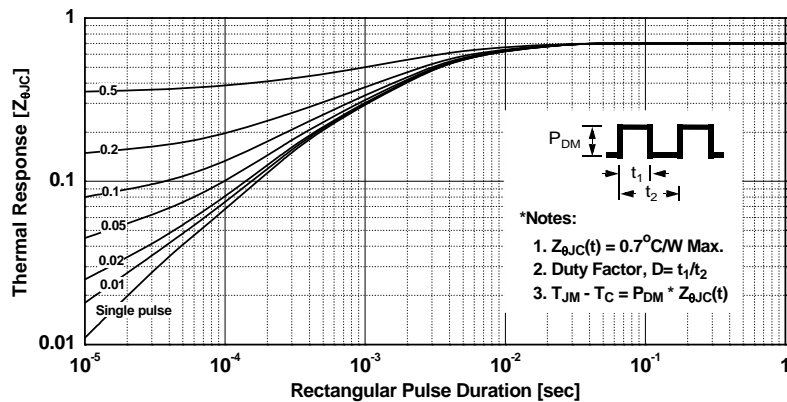


**Figure 11. Unclamped Inductive Switching Capability**

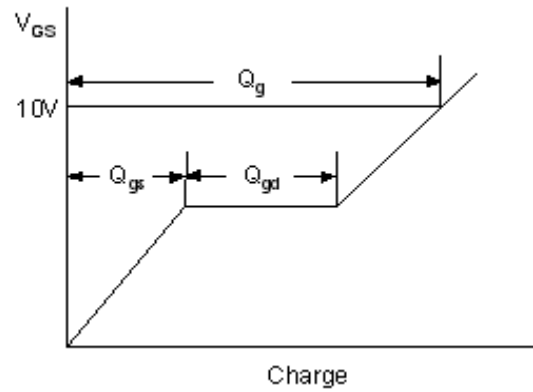
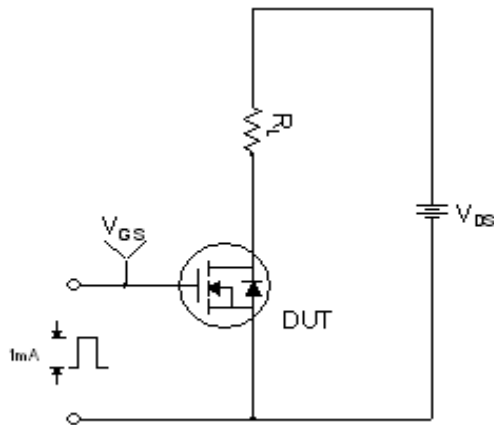


Typical Performance Characteristics (Continued)

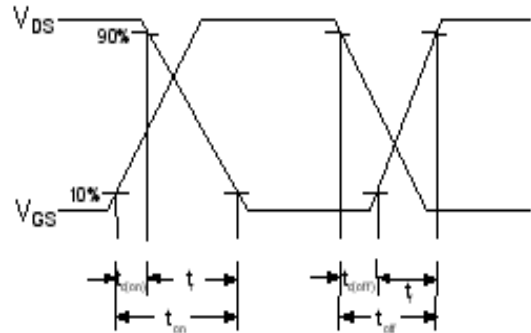
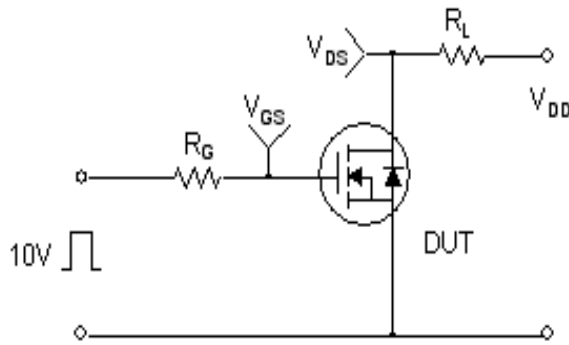
Figure 12. Transient Thermal Response Curve



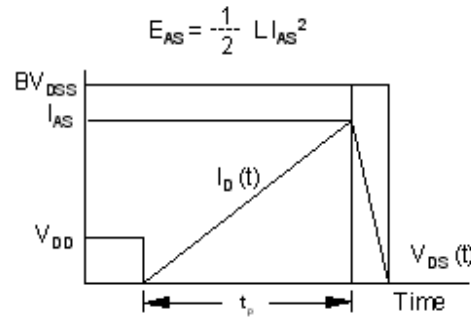
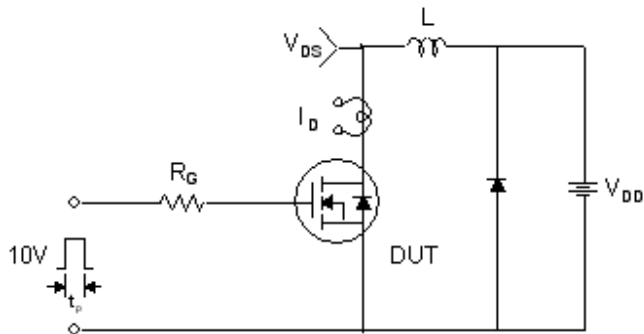
**Gate Charge Test Circuit & Waveform**



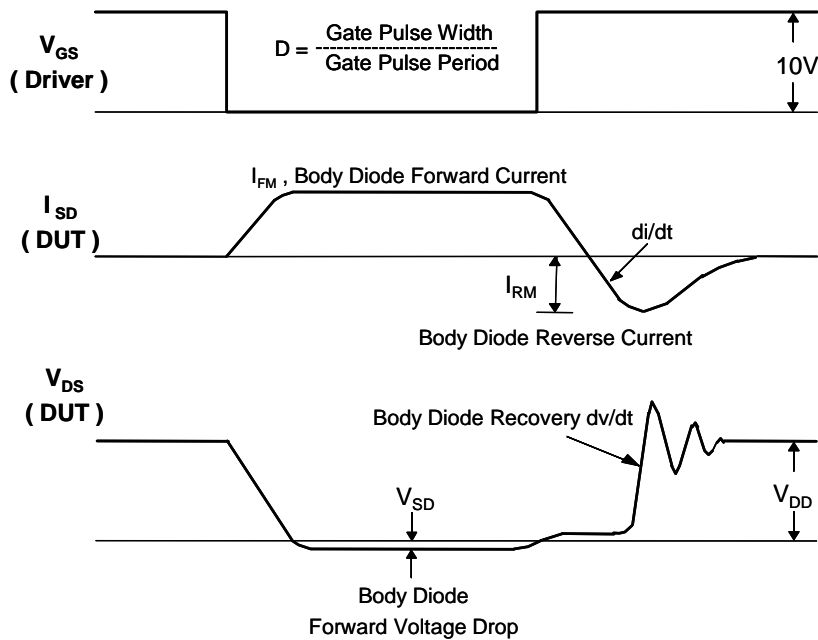
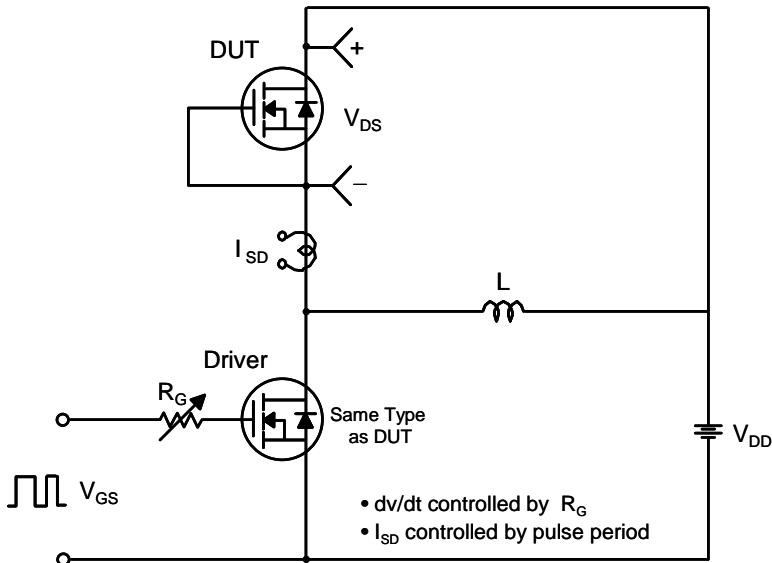
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

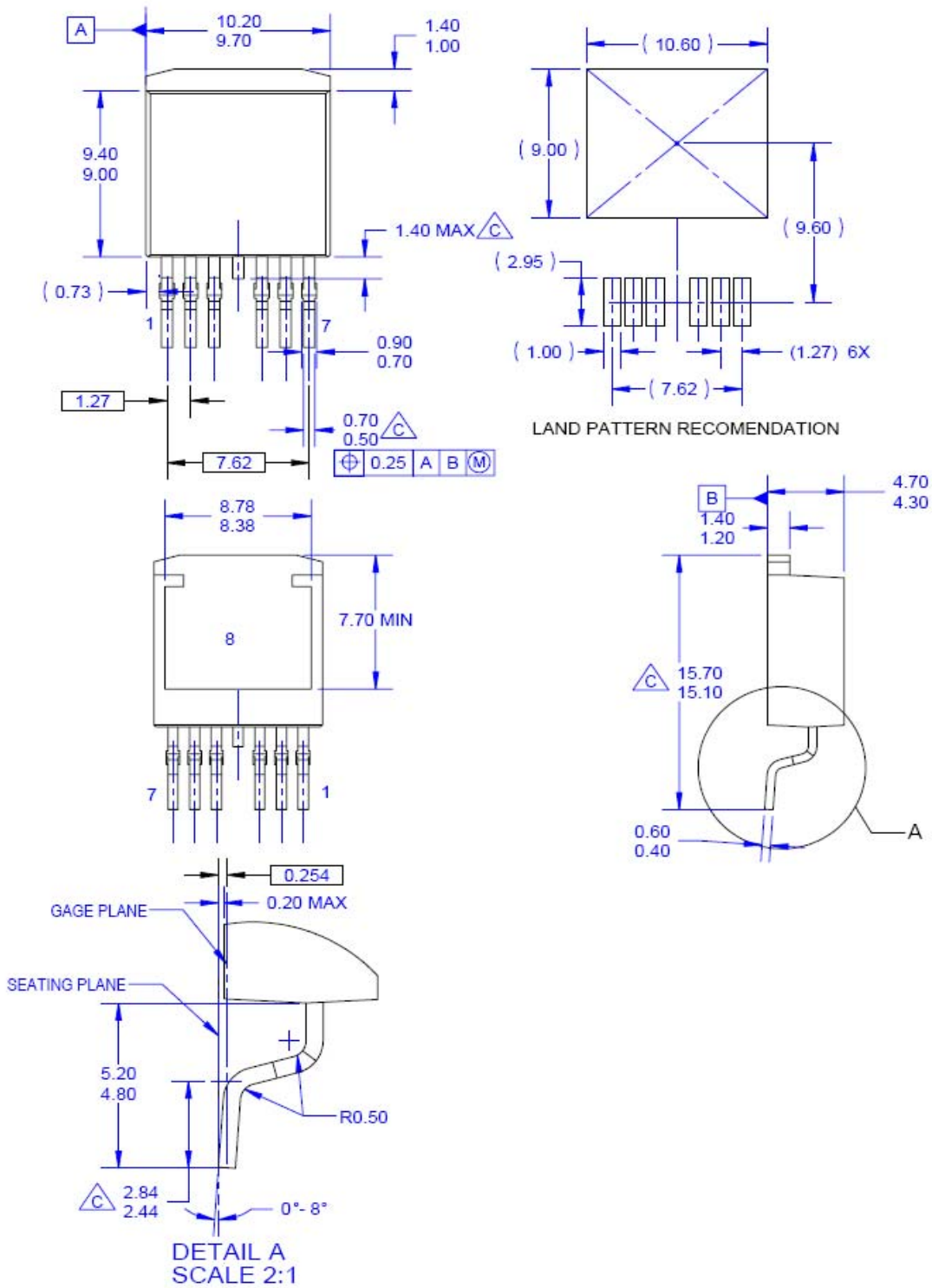


Peak Diode Recovery dv/dt Test Circuit & Waveforms



### Mechanical Dimensions

## D<sup>2</sup>PAK-7L



Dimensions in Millimeters





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- |                          |                                     |                                       |                       |
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