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# FDB86135

## N-Channel Shielded Gate PowerTrench® MOSFET

100V, 176A, 3.5mΩ

### Features

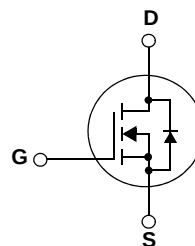
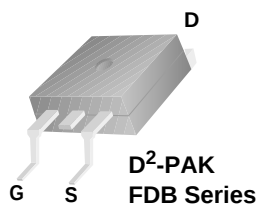
- Shielded Gate MOSFET Technology
- Max  $R_{DS(on)} = 3.5m\Omega$  at  $V_{GS} = 10V$ ,  $I_D = 75A$
- Fast Switching Speed
- Low Gate Charge
- High Performance Trench Technology for Extremely Low  $R_{DS(on)}$
- High Power and Current Handling Capability
- RoHS Compliant

### General Description

This N-Channel MOSFET is produced using Fairchild Semiconductor's advanced PowerTrench® process that incorporates Shielded Gate technology. This process has been optimized for the on-state resistance and yet maintain superior switching performance.

### Applications

- DC-DC primary bridge
- DC-DC Synchronous rectification
- Hot swap



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

| Symbol         | Parameter                                                       | Ratings     | Units         |
|----------------|-----------------------------------------------------------------|-------------|---------------|
| $V_{DSS}$      | Drain to Source Voltage                                         | 100         | V             |
| $V_{GSS}$      | Gate to Source Voltage                                          | $\pm 20$    | V             |
| $I_D$          | Drain Current - Continuous (Silicon Limited) $T_C = 25^\circ C$ | 176         | A             |
|                | - Continuous (Package Limited) $T_C = 25^\circ C$               | 120         |               |
|                | - Continuous $T_C = 25^\circ C$ (Note 1a)                       | 75          |               |
|                | - Pulsed                                                        | 704         | A             |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 3)                         | 658         | mJ            |
| $P_D$          | Power Dissipation - $T_C = 25^\circ C$ (Note 1a)                | 227         | W             |
|                | - $T_A = 25^\circ C$ (Note 1b)                                  | 2.4         | W/ $^\circ C$ |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range                         | -55 to +175 | $^\circ C$    |

### Thermal Characteristics

| Symbol          | Parameter                                         | Ratings | Units        |
|-----------------|---------------------------------------------------|---------|--------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case (Note 1)     | 0.66    | $^\circ C/W$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1a) | 62.5    |              |

### Package Marking and Ordering Information

| Device Marking | Device   | Package | Reel Size | Tape Width | Quantity |
|----------------|----------|---------|-----------|------------|----------|
| FDB86135       | FDB86135 | D2-PAK  | 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         | $I_D = 250\mu\text{A}$ , $V_{GS} = 0\text{V}$ , $T_C = 25^\circ\text{C}$ | 100 | -    | -         | V                  |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\mu\text{A}$ , Referenced to $25^\circ\text{C}$                | -   | 0.07 | -         | $V/^\circ\text{C}$ |
| $I_{DSS}$                            | Zero Gate Voltage Drain Current           | $V_{DS} = 80\text{V}$ , $V_{GS} = 0\text{V}$                             | -   | -    | 1         | $\mu\text{A}$      |
| $I_{GSS}$                            | 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               | $V_{GS} = V_{DS}$ , $I_D = 250\mu\text{A}$ | 2.0 | -   | 4.0 | V          |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{V}$ , $I_D = 75\text{A}$ | -   | 3.0 | 3.5 | m $\Omega$ |
| $g_{FS}$     | Forward Transconductance             | $V_{DS} = 10\text{V}$ , $I_D = 75\text{A}$ | -   | 167 | -   | S          |

**Dynamic Characteristics**

|              |                                  |                                                                     |   |      |      |    |
|--------------|----------------------------------|---------------------------------------------------------------------|---|------|------|----|
| $C_{iss}$    | Input Capacitance                | $V_{DS} = 25\text{V}$ , $V_{GS} = 0\text{V}$<br>$f = 1\text{MHz}$   | - | 5485 | 7295 | pF |
| $C_{oss}$    | Output Capacitance               |                                                                     | - | 2430 | 3230 | pF |
| $C_{rss}$    | Reverse Transfer Capacitance     |                                                                     | - | 210  | -    | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10V         | $V_{DS} = 80\text{V}$ , $I_D = 75\text{A}$<br>$V_{GS} = 10\text{V}$ | - | 89   | 116  | nC |
| $Q_{gs}$     | Gate to Source Gate Charge       |                                                                     | - | 24   | -    | nC |
| $Q_{gs2}$    | Gate Charge Threshold to Plateau |                                                                     | - | 8    | -    | nC |
| $Q_{gd}$     | Gate to Drain "Miller" Charge    |                                                                     | - | 25   | -    | nC |

**Switching Characteristics**

|              |                     |                                                                                             |   |    |     |    |
|--------------|---------------------|---------------------------------------------------------------------------------------------|---|----|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 50\text{V}$ , $I_D = 75\text{A}$<br>$V_{GS} = 10\text{V}$ , $R_{GEN} = 4.7\Omega$ | - | 22 | 54  | ns |
| $t_r$        | Turn-On Rise Time   |                                                                                             | - | 54 | 118 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |                                                                                             | - | 37 | 84  | ns |
| $t_f$        | Turn-Off Fall Time  |                                                                                             | - | 11 | 32  | ns |

**Drain-Source Diode Characteristics**

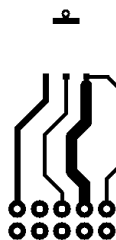
|          |                                       |                                                                      |   |     |      |    |
|----------|---------------------------------------|----------------------------------------------------------------------|---|-----|------|----|
| $V_{SD}$ | Drain to Source Diode Forward Voltage | $V_{GS} = 0\text{V}$ , $I_{SD} = 75\text{A}$ (Note 2)                | - | -   | 1.25 | V  |
| $t_{rr}$ | Reverse Recovery Time                 | $V_{GS} = 0\text{V}$ , $I_{SD} = 75\text{A}$ , $V_{DD} = 80\text{V}$ | - | 72  | -    | ns |
| $Q_{rr}$ | Reverse Recovery Charge               | $di_F/dt = 100\text{A}/\mu\text{s}$                                  | - | 129 | -    | nC |

**NOTES:**

1.  $R_{\theta JA}$  is determined with the device mounted on a 1 in<sup>2</sup> pad 2 oz copper pad on a 1.5 x 1.5 in. board of FR-4 material.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a) 40 °C/W when mounted on a 1 in<sup>2</sup> pad of 2 oz copper



b) 62.5 °C/W when mounted on a minimum pad of 2 oz copper

2. Pulse Test: Pulse Width < 300  $\mu\text{s}$ , Duty cycle < 2.0 %.  
3. Starting  $T_J = 25^\circ\text{C}$ ,  $L = 1\text{ mH}$ ,  $I_{AS} = 36.3\text{ A}$ ,  $V_{DD} = 100\text{ V}$ ,  $V_{GS} = 10\text{ V}$ .

## Typical Performance Characteristics

Figure 1. On-Region Characteristics

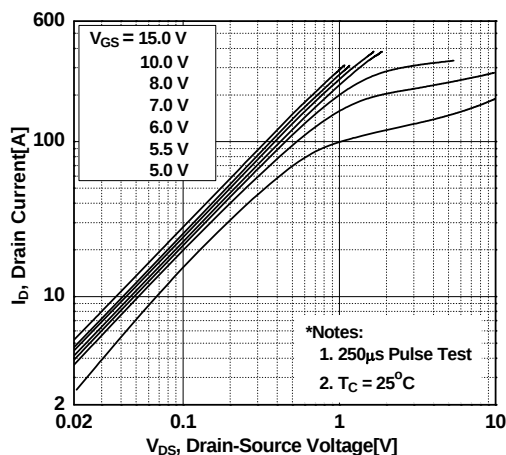


Figure 2. Transfer Characteristics

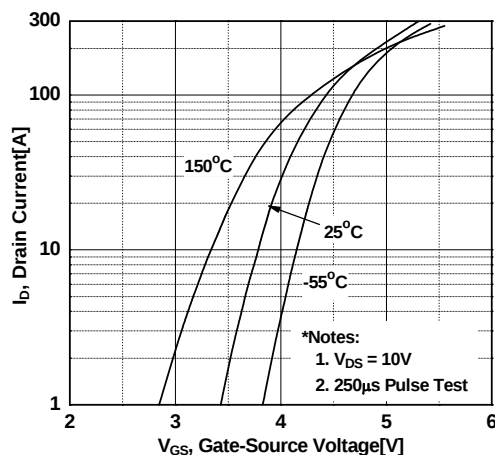


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

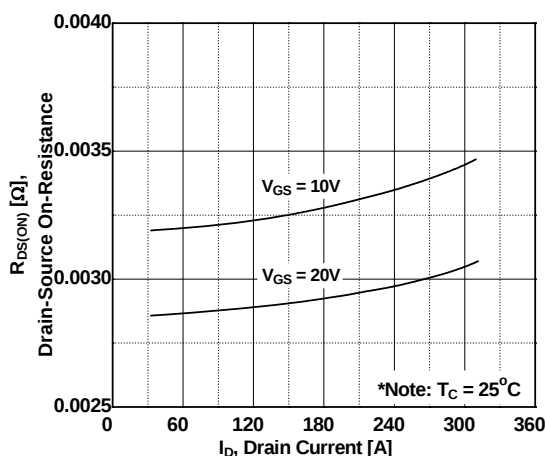


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

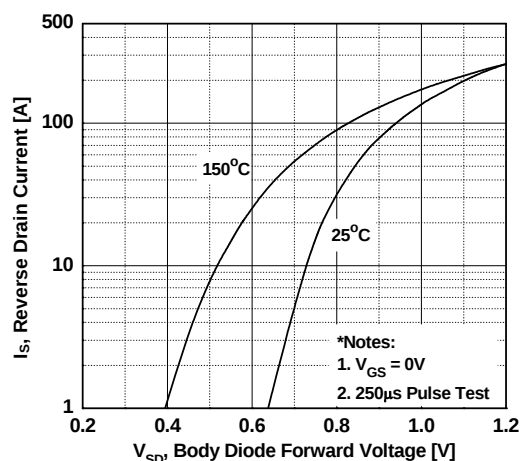


Figure 5. Capacitance Characteristics

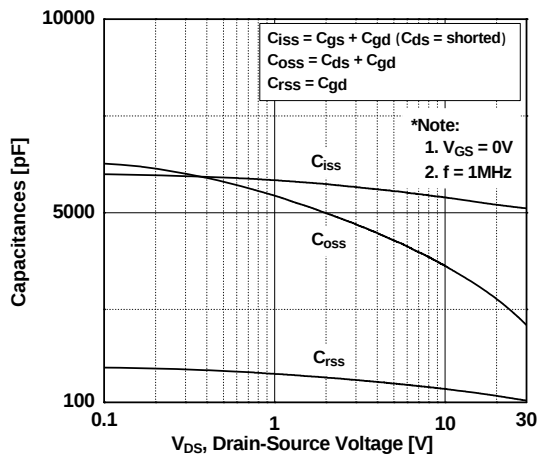
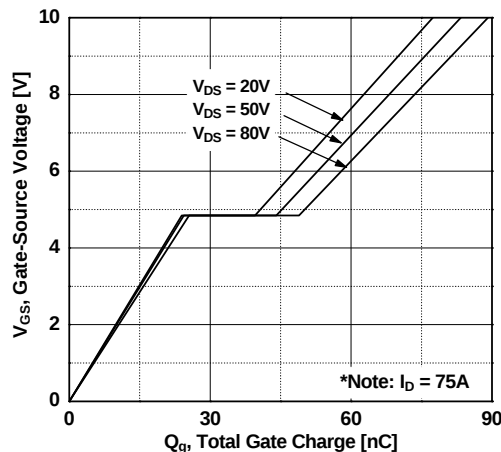
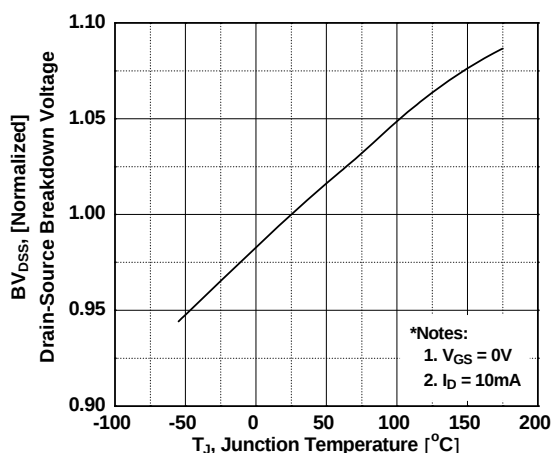


Figure 6. Gate Charge Characteristics

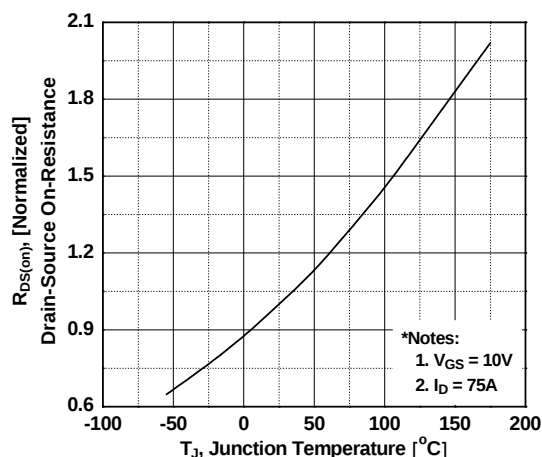


## Typical Performance Characteristics

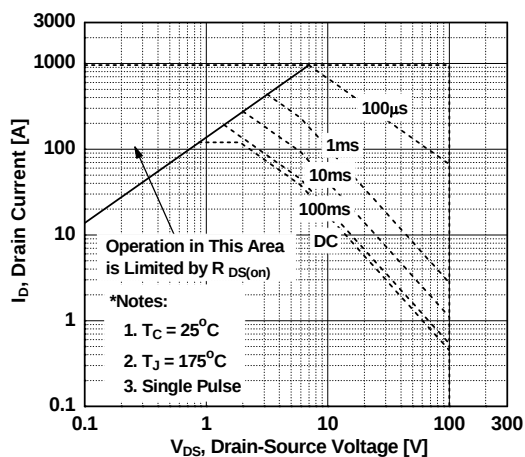
**Figure 7. Breakdown Voltage Variation vs. Temperature**



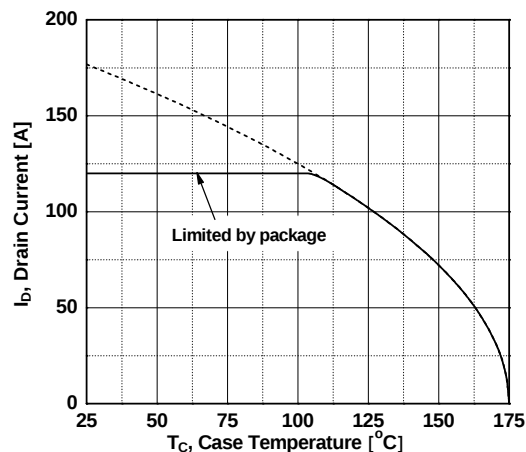
**Figure 8. On-Resistance Variation vs. Temperature**



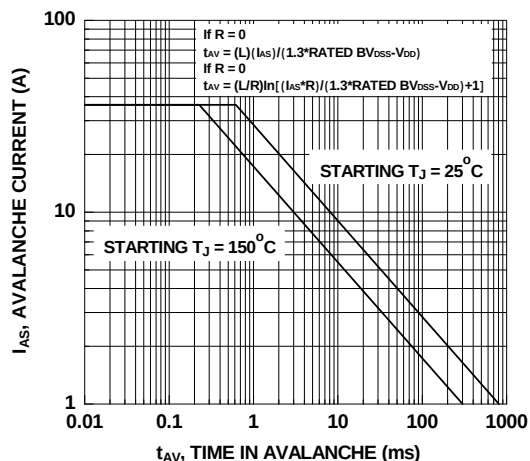
**Figure 9. Maximum Safe Operating Area**



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

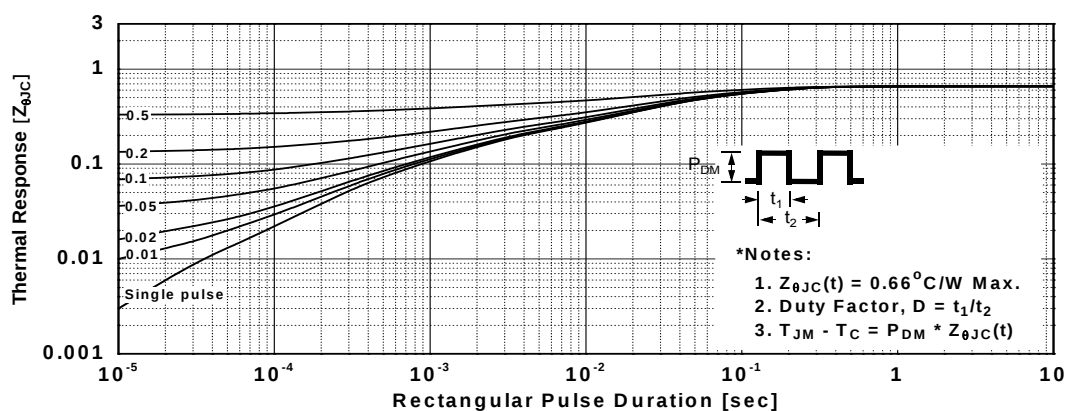


**Figure 11. Unclamped Inductive Switching Capability**

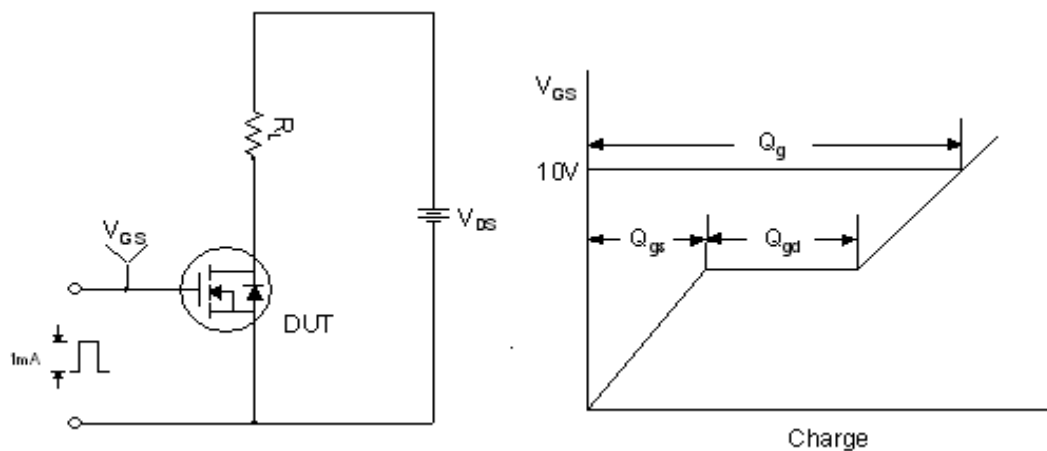


# Typical Performance Characteristics

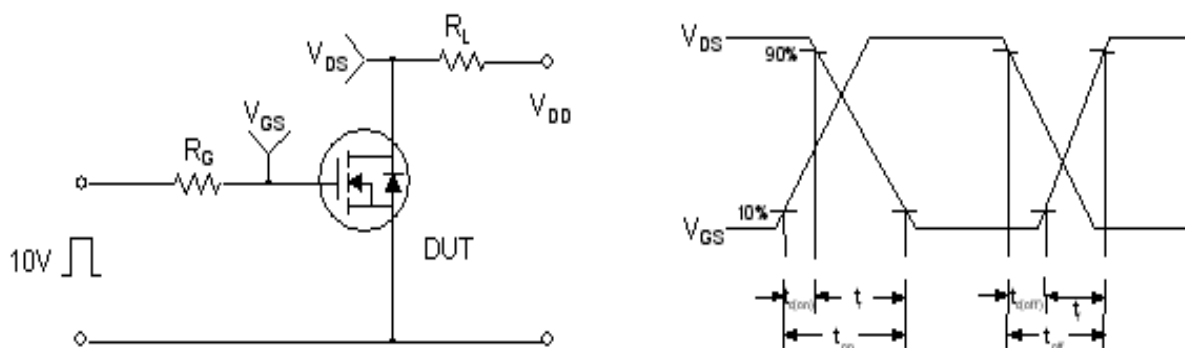
Figure 12. Transient Thermal Response Curve



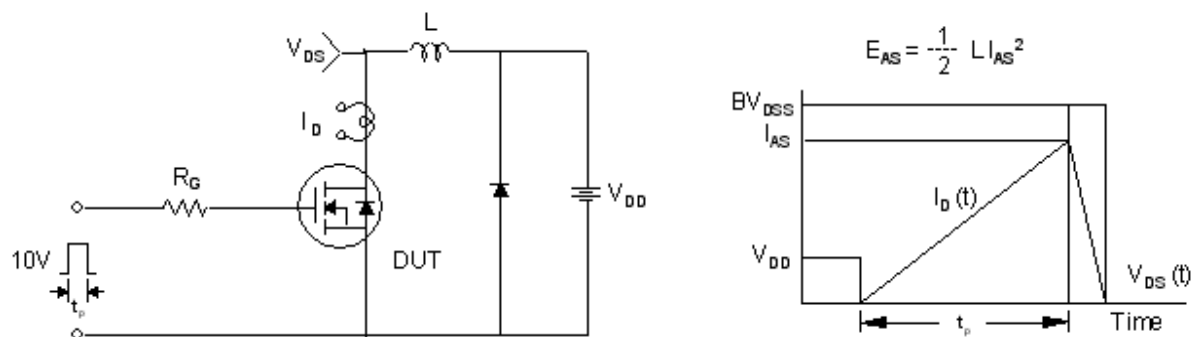
Gate Charge Test Circuit & Waveform



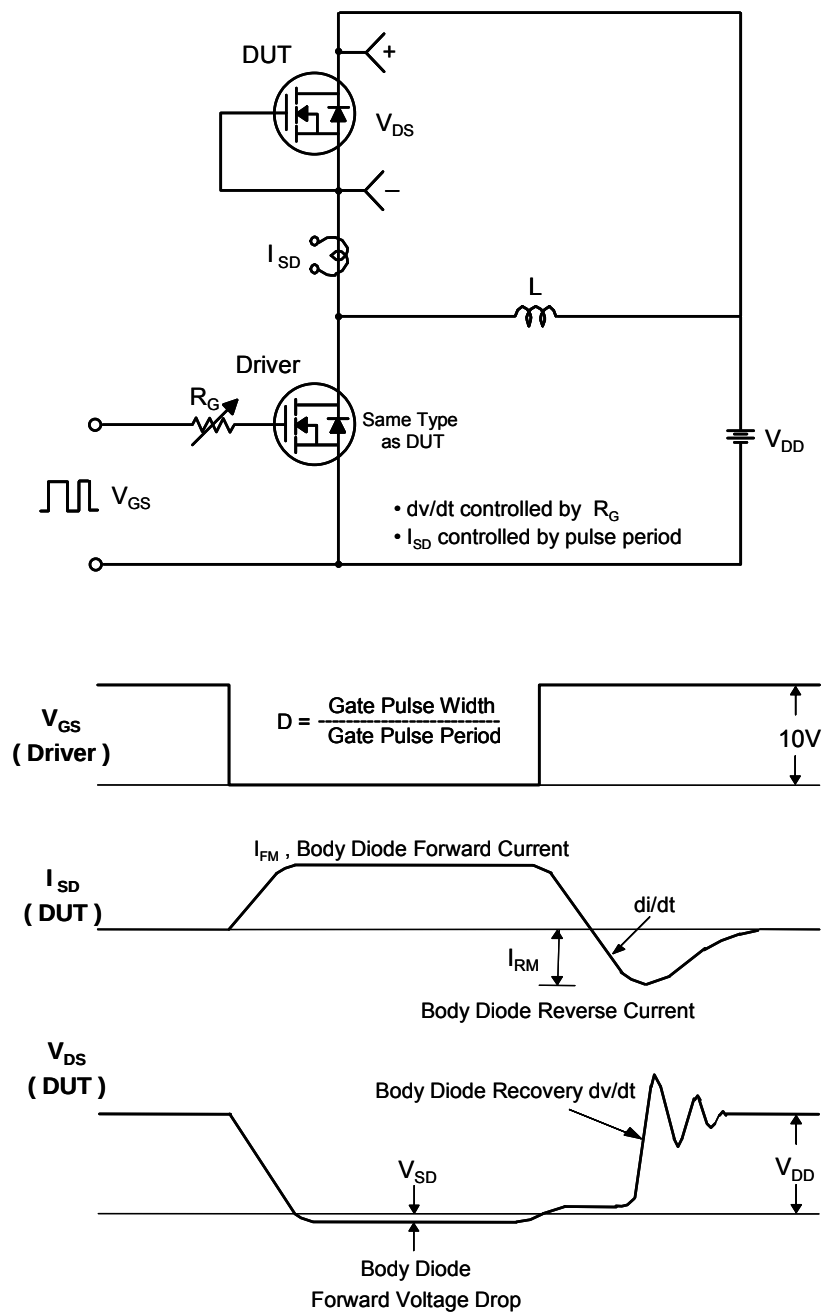
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

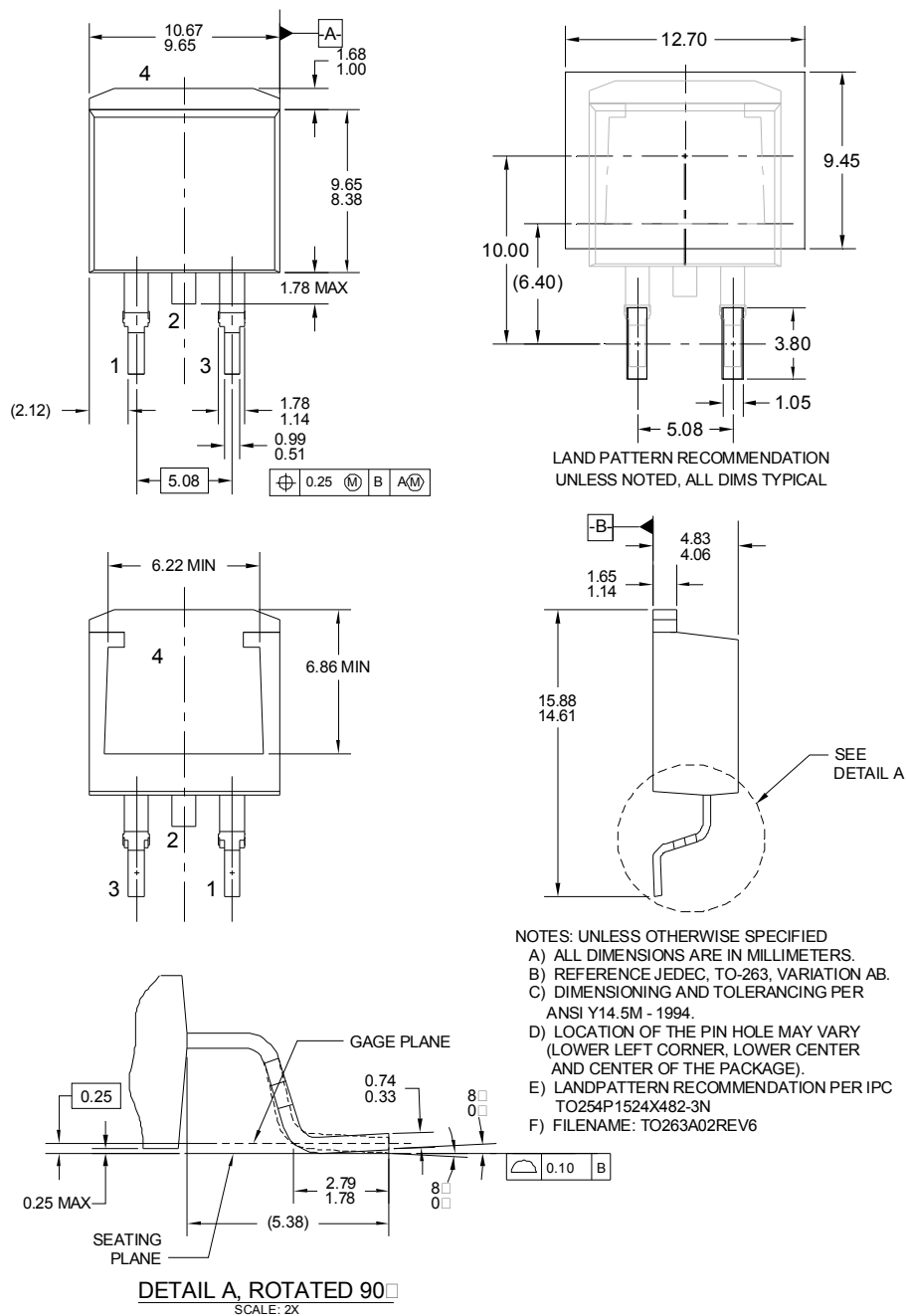


Peak Diode Recovery dv/dt Test Circuit & Waveforms



# Mechanical Dimensions

## D2-PAK



Dimensions in Millimeters



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