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# FDS4141

## P-Channel PowerTrench® MOSFET

-40V, -10.8A, 13.0mΩ

### Features

- Max  $r_{DS(on)}$  = 13.0mΩ at  $V_{GS} = -10V$ ,  $I_D = -10.5A$
- Max  $r_{DS(on)}$  = 19.0mΩ at  $V_{GS} = -4.5V$ ,  $I_D = -8.4A$
- High performance trench technology for extremely low  $r_{DS(on)}$
- RoHS Compliant

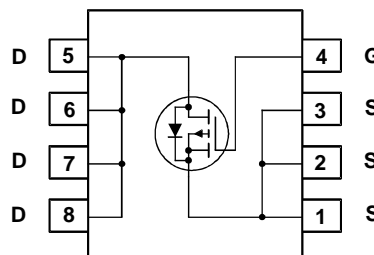
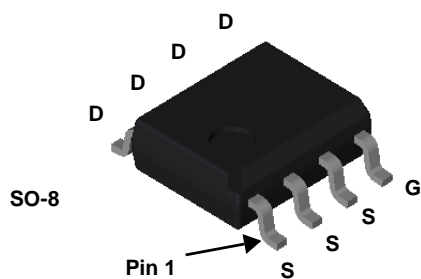


### General Description

This P-Channel MOSFET has been produced using On Semiconductor's proprietary PowerTrench® technology to deliver low  $r_{DS(on)}$  and optimized  $BV_{DSS}$  capability to offer superior performance benefit in the applications and optimized switching performance capability reducing power dissipation losses in converter/inverter applications.

### Applications

- Control switch in synchronous & non-synchronous buck
- Load switch
- Inverter



### MOSFET Maximum Ratings $T_A = 25^\circ\text{C}$ unless otherwise noted

| Symbol         | Parameter  | Ratings     | Units            |
|----------------|--|-------------|------------------|
| $V_{DS}$       | Drain to Source Voltage                              | -40         | V                |
| $V_{GS}$       | Gate to Source Voltage                               | $\pm 20$    | V                |
| $I_D$          | Drain Current -Continuous                            | -10.8       | A                |
|                | -Pulsed  | -36         |                  |
| $E_{AS}$       | Single Pulse Avalanche Energy (Note 3)               | 294         | mJ               |
| $P_D$          | Power Dissipation $T_A = 25^\circ\text{C}$ (Note 1a) | 5           | W                |
|                | Power Dissipation $T_A = 25^\circ\text{C}$ (Note 1b) | 2.5         |                  |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range     | -55 to +150 | $^\circ\text{C}$ |

### Thermal Characteristics

|                 |   |    |                    |
|-----------------|---|----|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case (Note 1)     | 25 | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1a) | 50 |                    |

### Package Marking and Ordering Information

| Device Marking | Device  | Package | Reel Size | Tape Width | Quantity  |
|----------------|---------|---------|-----------|------------|-----------|
| FDS4141        | FDS4141 | SO-8    | 13"       | 12mm       | 2500units |

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

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

### Off Characteristics

|                                      |   |  |     |     |           |               |
|--------------------------------------|---|--|-----|-----|-----------|---------------|
| $BV_{DSS}$                           | Drain to Source Breakdown Voltage         | $I_D = -250\mu\text{A}, V_{GS} = 0\text{V}$                | -40 |     |           | V             |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$ |     | -33 |           | mV/°C         |
| $I_{DSS}$                            | Zero Gate Voltage Drain Current           | $V_{DS} = -32\text{V}$ ,                                   |     |     | -1        | $\mu\text{A}$ |
| $I_{GSS}$                            | Gate to Source Leakage Current            | $V_{GS} = \pm 20\text{V}, V_{DS} = 0\text{V}$              |     |     | $\pm 100$ | nA            |

### On Characteristics

|  |  |  |      |      |      |            |
|--|--|--|------|------|------|------------|
| $V_{GS(th)}$                           | Gate to Source Threshold Voltage                         | $V_{GS} = V_{DS}, I_D = -250\mu\text{A}$                             | -1.0 | -1.6 | -3.0 | V          |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$           |      | 5.3  |      | mV/°C      |
| $r_{DS(on)}$                           | Static Drain to Source On Resistance                     | $V_{GS} = -10\text{V}, I_D = -10.5\text{A}$                          |      | 11.0 | 13.0 | m $\Omega$ |
|  |  | $V_{GS} = -4.5\text{V}, I_D = -8.4\text{A}$                          |      | 15.2 | 19.0 |            |
|  |  | $V_{GS} = -10\text{V}, I_D = -10.5\text{A}, T_J = 125^\circ\text{C}$ |      | 16.8 | 19.9 |            |
| $g_{FS}$                               | Forward Transconductance                                 | $V_{DD} = -5\text{V}, I_D = -10.5\text{A}$                           |      | 37   |      | S          |

### Dynamic Characteristics

|           |                              |  |                   |      |      |          |
|-----------|------------------------------|--|-------------------|------|------|----------|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = -20\text{V}, V_{GS} = 0\text{V},$<br>$f = 1\text{MHz}$ |                   | 2005 | 2670 | pF       |
| $C_{oss}$ | Output Capacitance           |  |                   | 355  | 475  | pF       |
| $C_{rss}$ | Reverse Transfer Capacitance |  |                   | 190  | 285  | pF       |
| $R_g$     | Gate Resistance              |  | $f = 1\text{MHz}$ | 5    |      | $\Omega$ |

### Switching Characteristics

|              |                               |   |                                      |  |    |    |    |    |
|--------------|-------------------------------|---|--------------------------------------|--|----|----|----|----|
| $t_{d(on)}$  | Turn-On Delay Time            | $V_{DD} = -20\text{V}, I_D = -10.5\text{A},$<br>$V_{GS} = -10\text{V}, R_{GEN} = 6\Omega$ |                                      | 10   | 20 | ns |    |    |
| $t_r$        | Rise Time                     |   |                                      | 5  | 10 | ns |    |    |
| $t_{d(off)}$ | Turn-Off Delay Time           |   |                                      | 42   | 68 | ns |    |    |
| $t_f$        | Fall Time                     |   |                                      | 12   | 22 | ns |    |    |
| $Q_g$        | Total Gate Charge             |   | $V_{GS} = 0\text{V to } -10\text{V}$ |  | 35 | 49 | nC |    |
| $Q_g$        | Total Gate Charge             |   | $V_{GS} = 0\text{V to } -5\text{V}$  | $V_{DD} = -20\text{V},$<br>$I_D = -10.5\text{A}$ |    | 19 | 27 | nC |
| $Q_{gs}$     | Gate to Source Charge         |   |                                      |  |    | 6  |    | nC |
| $Q_{gd}$     | Gate to Drain "Miller" Charge |   |                                      |  | 7  |    | nC |    |

### Drain-Source Diode Characteristics

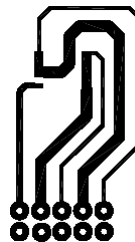
|          |                                       |  |  |      |      |    |
|----------|---------------------------------------|--|--|------|------|----|
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS} = 0\text{V}, I_S = -10.5\text{A}$ (Note 2)     |  | -0.8 | -1.3 | V  |
|          |                                       | $V_{GS} = 0\text{V}, I_S = -2.1\text{A}$ (Note 2)      |  | -0.7 | -1.2 |    |
| $t_{rr}$ | Reverse Recovery Time                 | $I_F = -10.5\text{A}, di/dt = 100\text{A}/\mu\text{s}$ |  | 26   | 42   | ns |
| $Q_{rr}$ | Reverse Recovery Charge               |  |  | 14   | 26   | nC |

#### NOTES:

1.  $R_{\theta JA}$  is determined with the device mounted on a  $1\text{in}^2$  pad 2 oz copper pad on a  $1.5 \times 1.5\text{in.}$  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)  $50^\circ\text{C}/\text{W}$  when mounted on a  $1\text{in}^2$  pad of 2 oz copper.

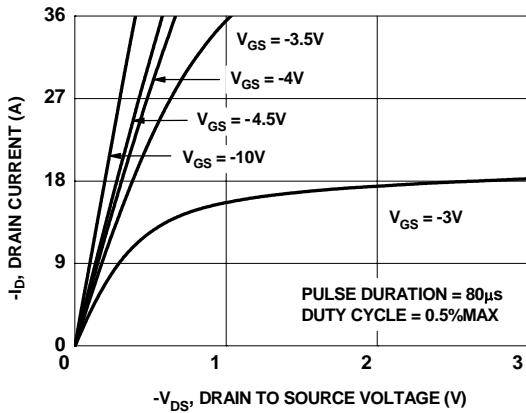


b)  $125^\circ\text{C}/\text{W}$  when mounted on a minimum pad.

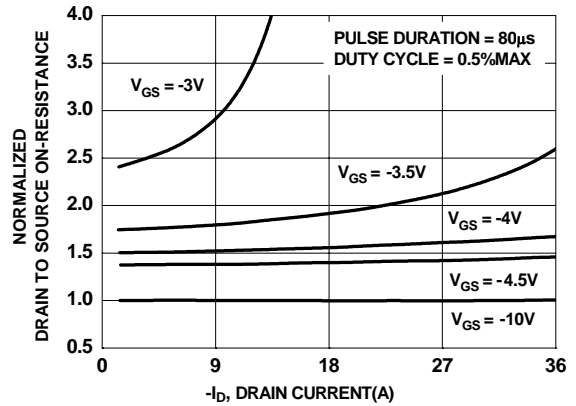
2. Pulse Test: Pulse Width <  $300\mu\text{s}$ , Duty cycle < 2.0%.

3. UIL condition: Starting  $T_J = 25^\circ\text{C}$ ,  $L = 3\text{mH}$ ,  $I_{AS} = -14\text{A}$ ,  $V_{DD} = -40\text{V}$ ,  $V_{GS} = -10\text{V}$ .

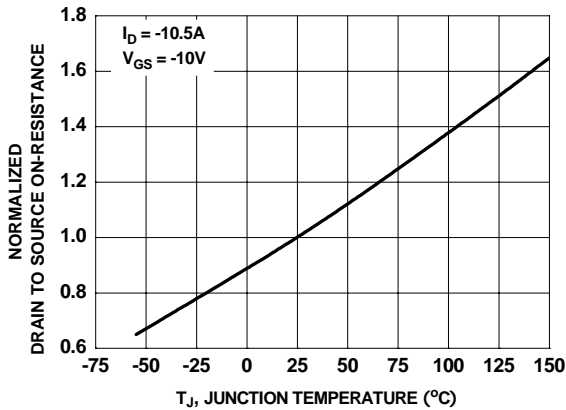
**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted



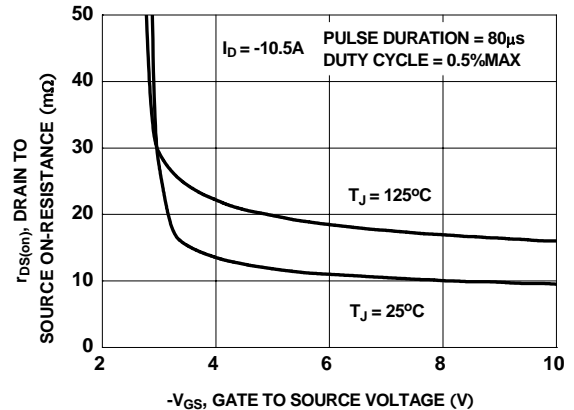
**Figure 1. On-Region Characteristics**



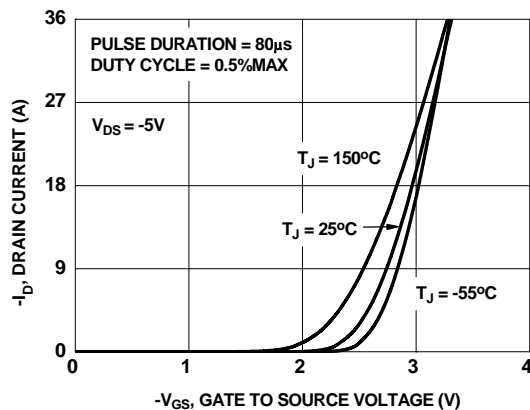
**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**



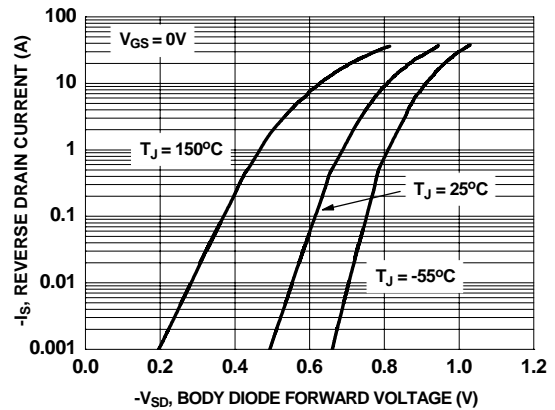
**Figure 3. Normalized On-Resistance vs Junction Temperature**



**Figure 4. On-Resistance vs Gate to Source Voltage**

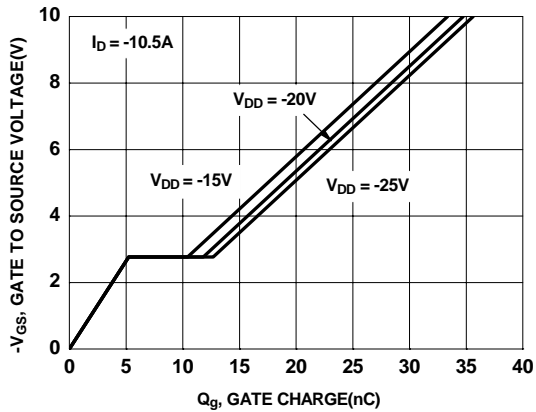


**Figure 5. Transfer Characteristics**

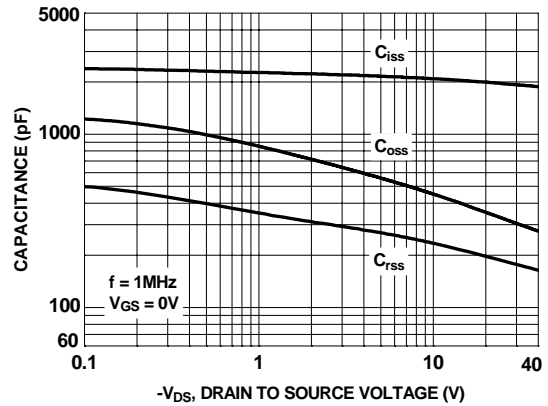


**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

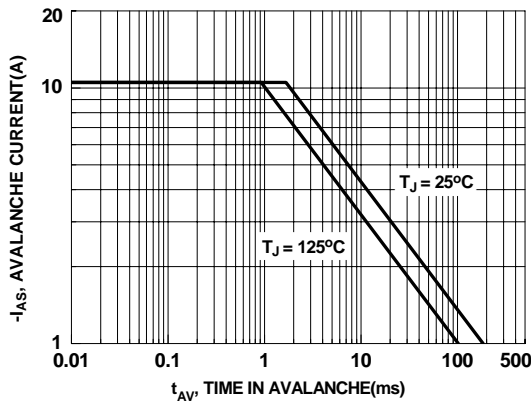
**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted



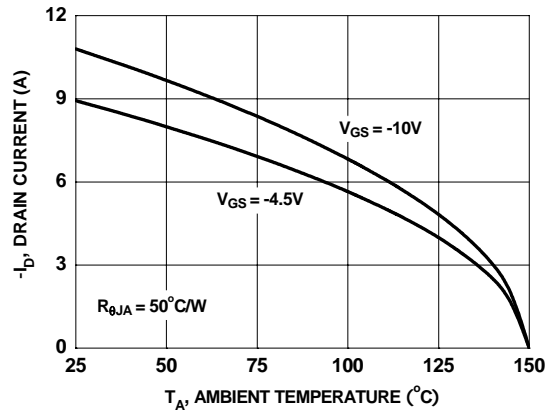
**Figure 7. Gate Charge Characteristics**



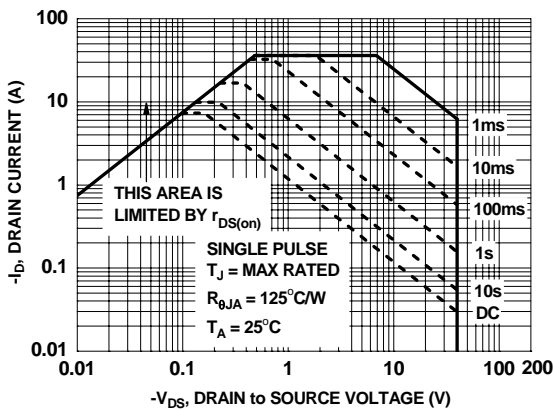
**Figure 8. Capacitance vs Drain to Source Voltage**



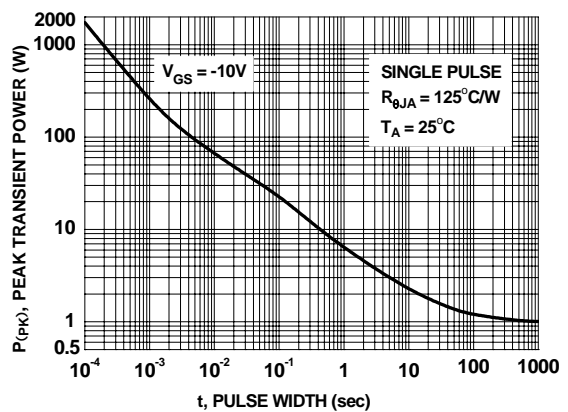
**Figure 9. Unclamped Inductive Switching Capability**



**Figure 10. Maximum Continuous Drain Current vs Ambient Temperature**

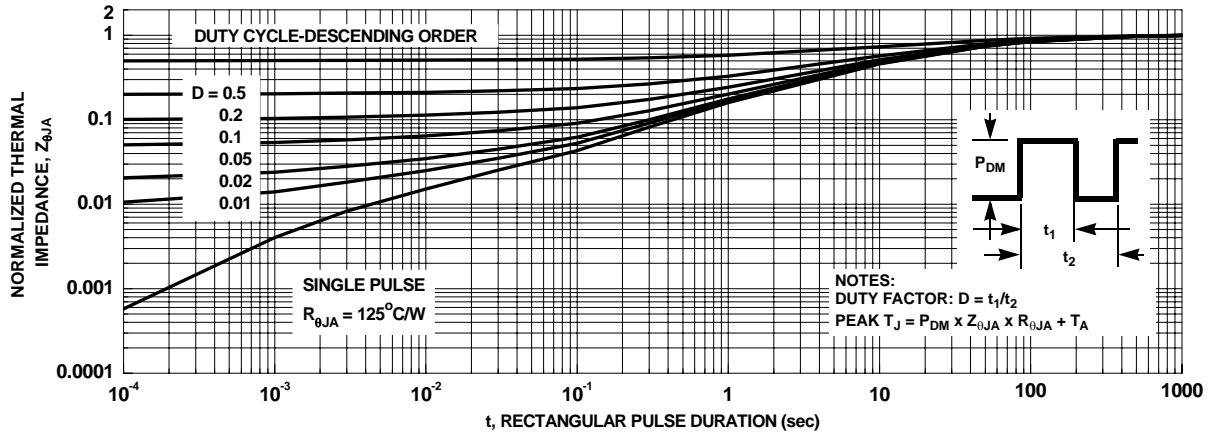


**Figure 11. Forward Bias Safe Operating Area**



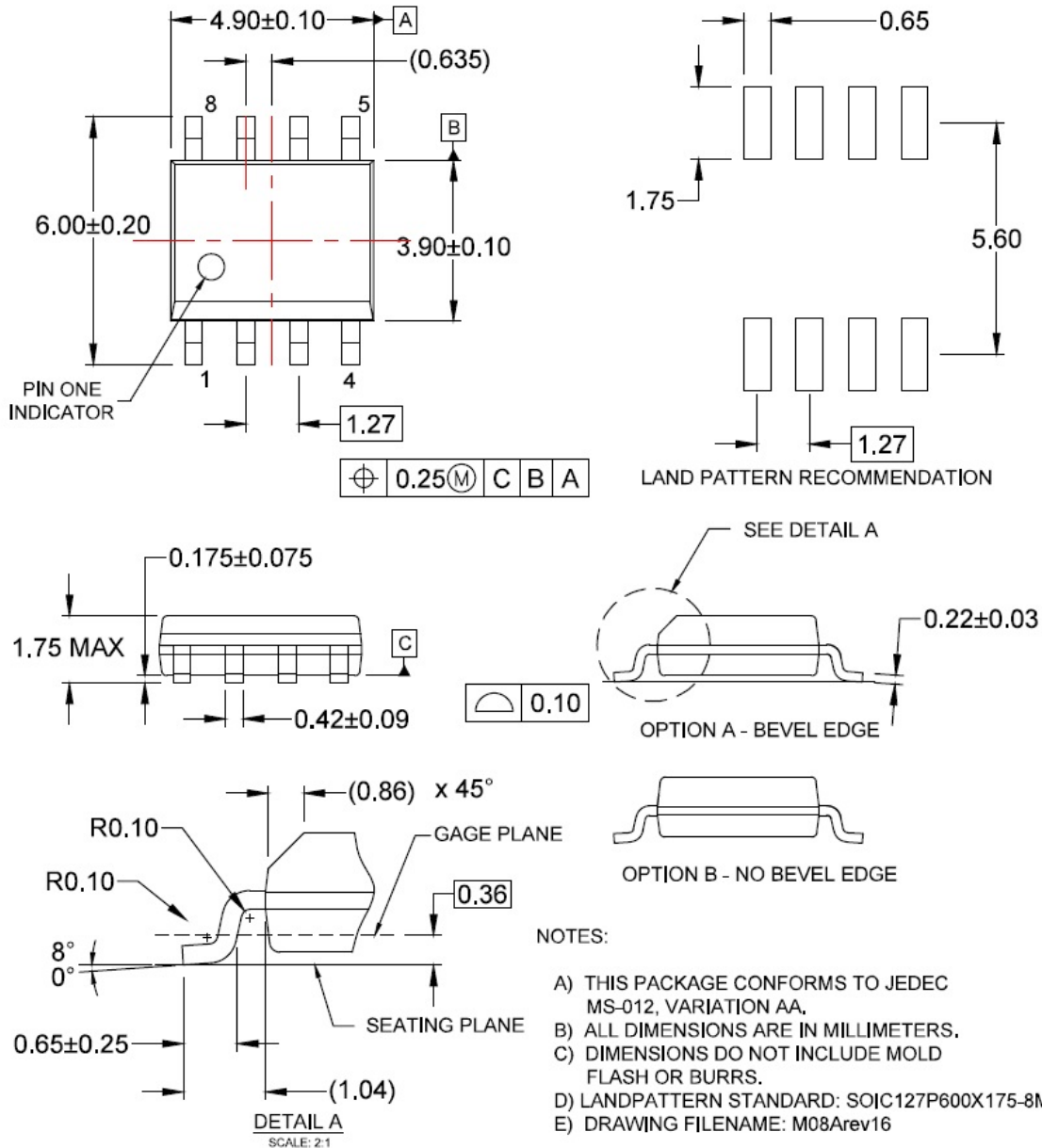
**Figure 12. Single Pulse Maximum Power Dissipation**

**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted



**Figure 13. Transient Thermal Response Curve**

## Dimensional Outline and Pad Layout



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