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March 2015



# FDD8778/FDU8778 N-Channel PowerTrench<sup>®</sup> MOSFET 25V, 35A, 14mΩ

## Features

- Max  $r_{DS(on)}$  = 14.0mΩ at  $V_{GS} = 10V$ ,  $I_D = 35A$
- Max  $r_{DS(on)}$  = 21.0mΩ at  $V_{GS} = 4.5V$ ,  $I_D = 33A$
- Low gate charge:  $Q_{g(TOT)} = 12.6nC(Typ)$ ,  $V_{GS} = 10V$
- Low gate resistance
- RoHS compliant

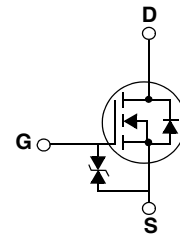
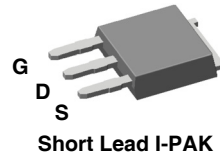
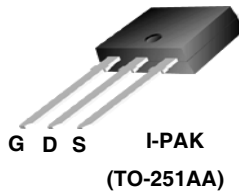
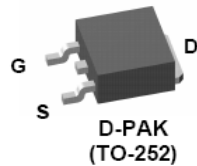


## General Description

This N-Channel MOSFET has been designed specifically to improve the overall efficiency of DC/DC converters using either synchronous or conventional switching PWM controllers. It has been optimized for low gate charge, low  $r_{DS(on)}$  and fast switching speed.

## Application

- DC-DC for Desktop Computers and Servers
- VRM for Intermediate Bus Architecture



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

| Symbol         | Parameter                                   | Ratings    | Units |
|----------------|---|------------|-------|
| $V_{DS}$       | Drain to Source Voltage                     | 25         | V     |
| $V_{GS}$       | Gate to Source Voltage                      | ±20        | V     |
| $I_D$          | Drain Current -Continuous (Package Limited) | 35         | A     |
|                | -Continuous (Die Limited)                   | 40         |       |
|                | -Pulsed (Note 1)                            | 145        |       |
| $E_{AS}$       | Single Pulse Avalanche Energy (Note 2)      | 24         | mJ    |
| $P_D$          | Power Dissipation                           | 39         | W     |
| $T_J, T_{STG}$ | Operating and Storage Temperature           | -55 to 175 | °C    |

## Thermal Characteristics

|                 |  |     |      |
|-----------------|--|-----|------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case TO-252, TO-251                              | 3.8 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient TO-252, TO-251                           | 100 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient TO-252, 1in <sup>2</sup> copper pad area | 52  | °C/W |

## Package Marking and Ordering Information

| Device Marking | Device       | Package  | Reel Size | Tape Width | Quantity   |
|----------------|--------------|----------|-----------|------------|------------|
| FDD8778        | FDD8778      | TO-252AA | 13"       | 16mm       | 2500 units |
| FDU8778        | FDU8778      | TO-251AA | N/A(Tube) | N/A        | 75 units   |
| FDU8778        | FDU8778_F071 | TO-251AA | N/A(Tube) | N/A        | 75 units   |

**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         | $I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$                             | 25 |      |          | V                    |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\mu\text{A}$ , referenced to $25^\circ\text{C}$              |    | 17.2 |          | mV/ $^\circ\text{C}$ |
| $I_{DSS}$                            | Zero Gate Voltage Drain Current           | $V_{DS} = 20\text{V}, V_{GS} = 0\text{V}$<br>$T_J = 150^\circ\text{C}$ |    |      | 1<br>250 | $\mu\text{A}$        |
| $I_{GSS}$                            | Gate to Source Leakage Current            | $V_{GS} = \pm 20\text{V}$  |    |      | $\pm 10$ | $\mu\text{A}$        |

**On Characteristics**

|  |  |   |     |                      |                      |                      |
|--|--|---|-----|----------------------|----------------------|----------------------|
| $V_{GS(th)}$                           | Gate to Source Threshold Voltage                         | $V_{GS} = V_{DS}, I_D = 250\mu\text{A}$   | 1.2 | 1.5                  | 2.5                  | 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/ $^\circ\text{C}$ |
| $r_{DS(on)}$                           | Drain to Source On Resistance                            | $V_{GS} = 10\text{V}, I_D = 35\text{A}$<br>$V_{GS} = 4.5\text{V}, I_D = 33\text{A}$<br>$V_{GS} = 10\text{V}, I_D = 35\text{A}$<br>$T_J = 175^\circ\text{C}$ |     | 11.6<br>15.7<br>18.2 | 14.0<br>21.0<br>23.8 | $\text{m}\Omega$     |

**Dynamic Characteristics**

|           |                              |  |                   |     |     |    |
|-----------|------------------------------|--|-------------------|-----|-----|----|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = 13\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$ |                   | 635 | 845 | pF |
| $C_{oss}$ | Output Capacitance           |  |                   | 160 | 215 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance |  |                   | 108 | 162 | pF |
| $R_g$     | Gate Resistance              |  | $f = 1\text{MHz}$ |     | 1.3 |    |

**Switching Characteristics**

|              |                               |   |   |     |      |    |
|--------------|-------------------------------|---|---|-----|------|----|
| $t_{d(on)}$  | Turn-On Delay Time            | $V_{DD} = 13\text{V}, I_D = 35\text{A}$<br>$V_{GS} = 10\text{V}, R_{GS} = 27\Omega$ |   | 6   | 12   | ns |
| $t_r$        | Rise Time                     |   |   | 22  | 35   | ns |
| $t_{d(off)}$ | Turn-Off Delay Time           |   |   | 43  | 69   | ns |
| $t_f$        | Fall Time                     |   |   | 32  | 51   | ns |
| $Q_{g(TOT)}$ | Total Gate Charge at 10V      |   | $V_{GS} = 0\text{V to } 10\text{V}$                                 |     | 12.6 | 18 |
| $Q_{g(5)}$   | Total Gate Charge at 5V       | $V_{GS} = 0\text{V to } 5\text{V}$  | $V_{DD} = 13\text{V}$<br>$I_D = 35\text{A}$<br>$I_g = 1.0\text{mA}$ | 6.7 | 9.4  | nC |
| $Q_{gs}$     | Gate to Source Gate Charge    |   |   | 2.1 |      | nC |
| $Q_{gd}$     | Gate to Drain "Miller" Charge |   |   | 3.2 |      | nC |

**Drain-Source Diode Characteristics**

|          |                                       |  |  |              |             |    |
|----------|---------------------------------------|--|--|--------------|-------------|----|
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS} = 0\text{V}, I_S = 35\text{A}$<br>$V_{GS} = 0\text{V}, I_S = 15\text{A}$ |  | 1.03<br>0.89 | 1.25<br>1.2 | V  |
| $t_{rr}$ | Reverse Recovery Time                 | $I_F = 35\text{A}, di/dt = 100\text{A}/\mu\text{s}$                              |  | 25           | 38          | ns |
| $Q_{rr}$ | Reverse Recovery Charge               | $I_F = 35\text{A}, di/dt = 100\text{A}/\mu\text{s}$                              |  | 17           | 26          | nC |

**Notes:**

- 1: Pulse time < 300 $\mu\text{s}$ , Duty cycle = 2%.
- 2: Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.1\text{mH}$ ,  $I_{AS} = 22\text{A}$ ,  $V_{DD} = 23\text{V}$ ,  $V_{GS} = 10\text{V}$ .

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

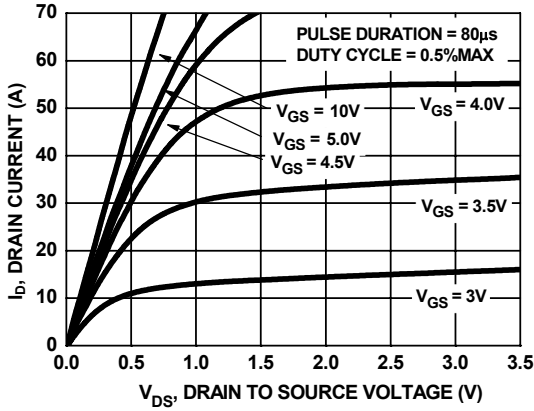


Figure 1. On Region Characteristics

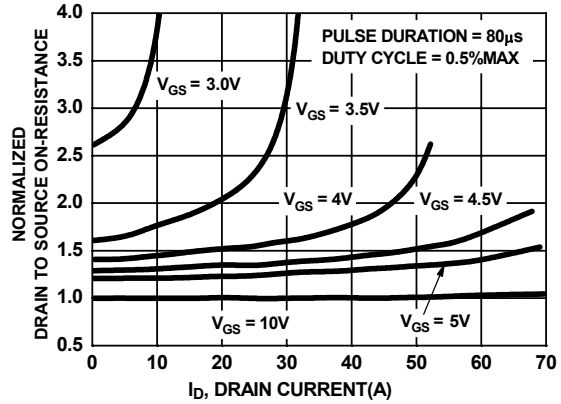


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

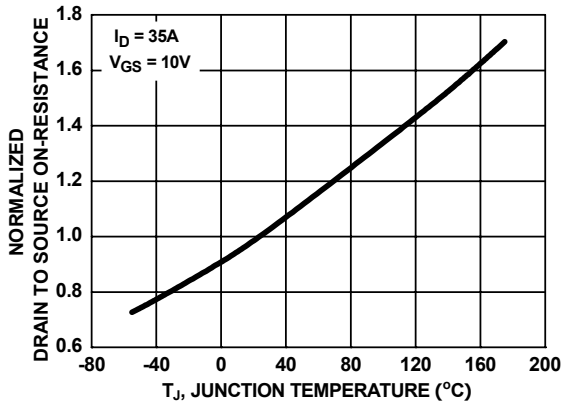


Figure 3. Normalized On Resistance vs Junction Temperature

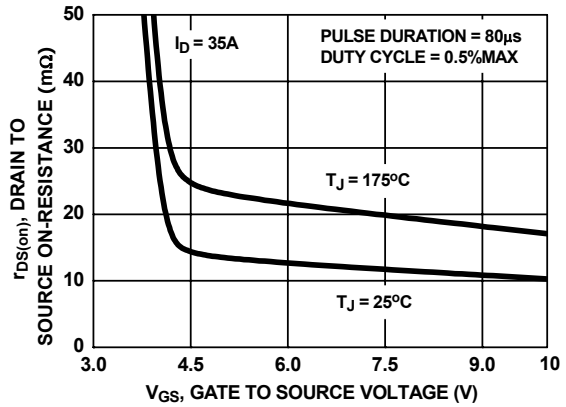


Figure 4. On-Resistance vs Gate to Source Voltage

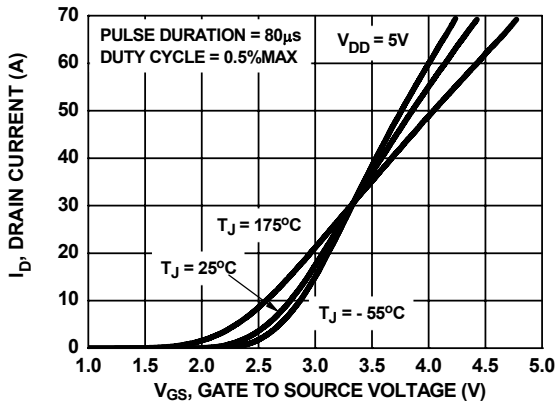


Figure 5. Transfer Characteristics

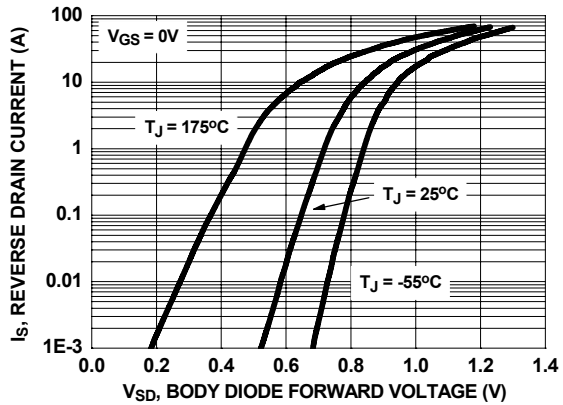


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

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

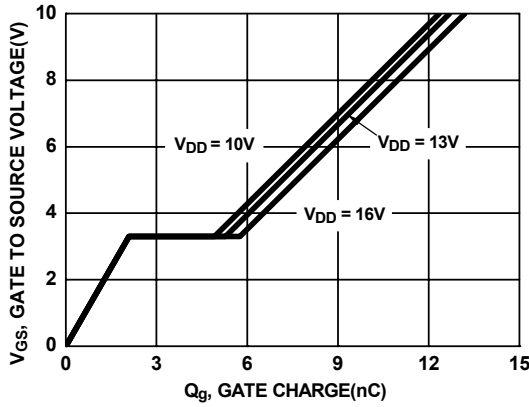


Figure 7. Gate Charge Characteristics

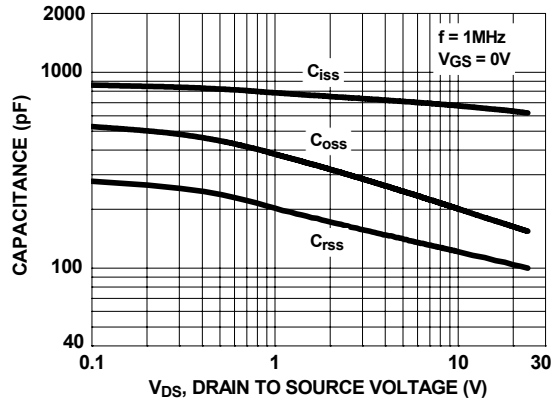


Figure 8. Capacitance vs Drain to Source Voltage

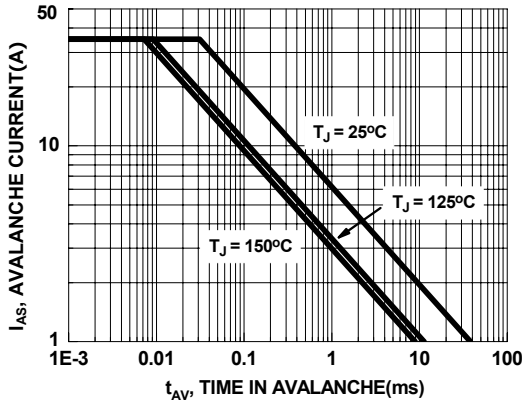


Figure 9. Unclamped Inductive Switching Capability

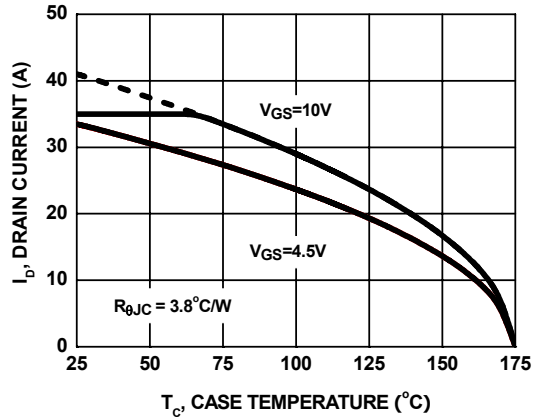


Figure 10. Maximum Continuous Drain Current vs Case Temperature

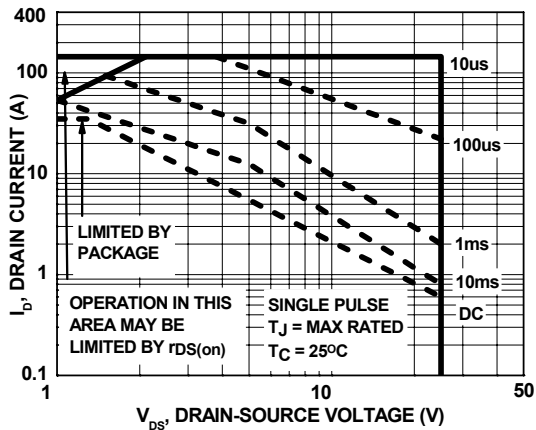


Figure 11. Forward Bias Safe Operating Area

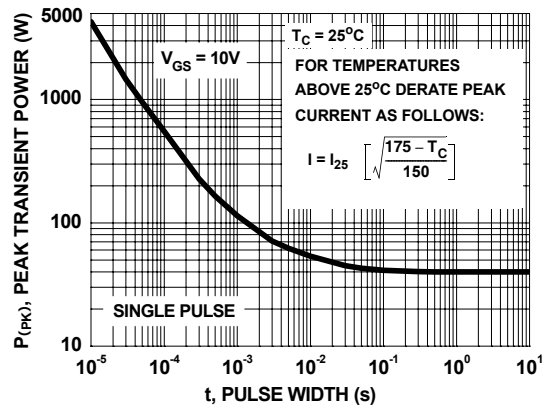


Figure 12. Single Pulse Maximum Power Dissipation

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

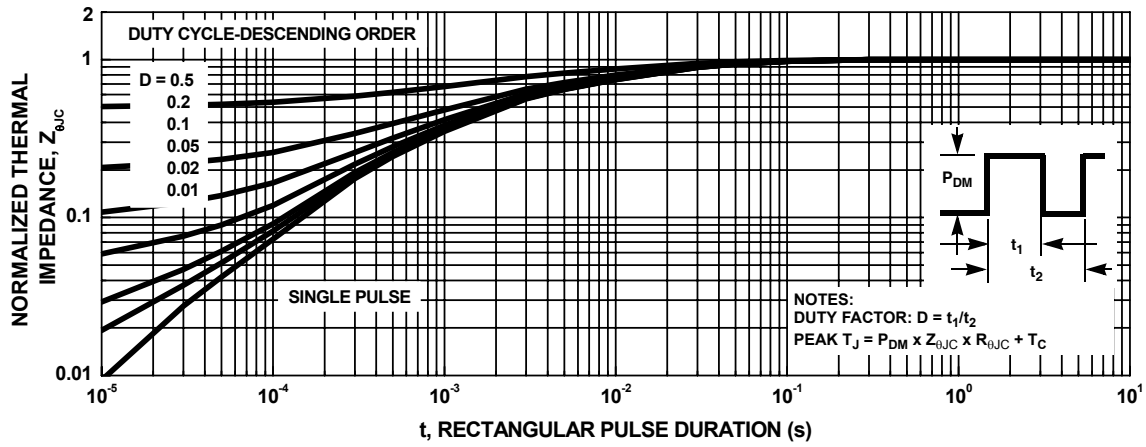
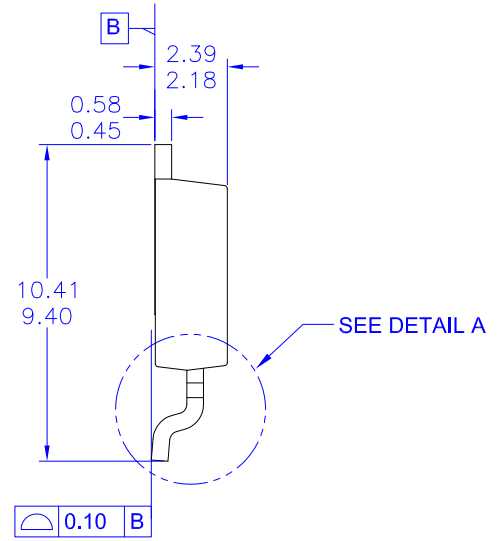
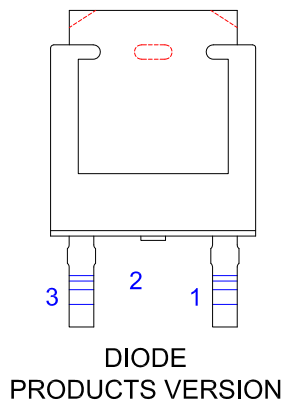
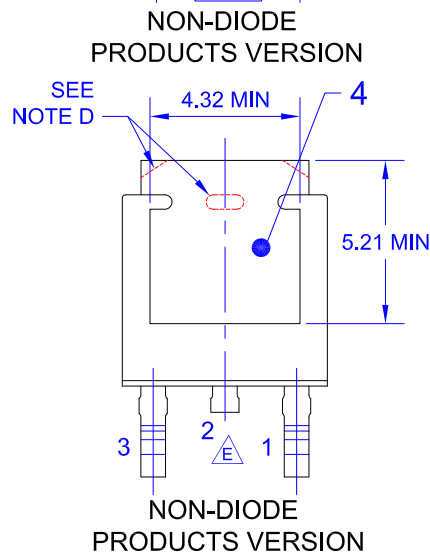
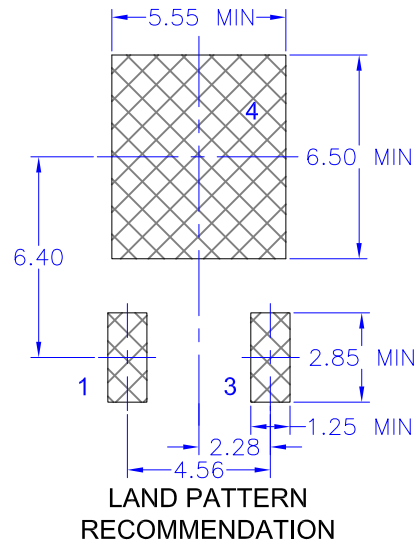
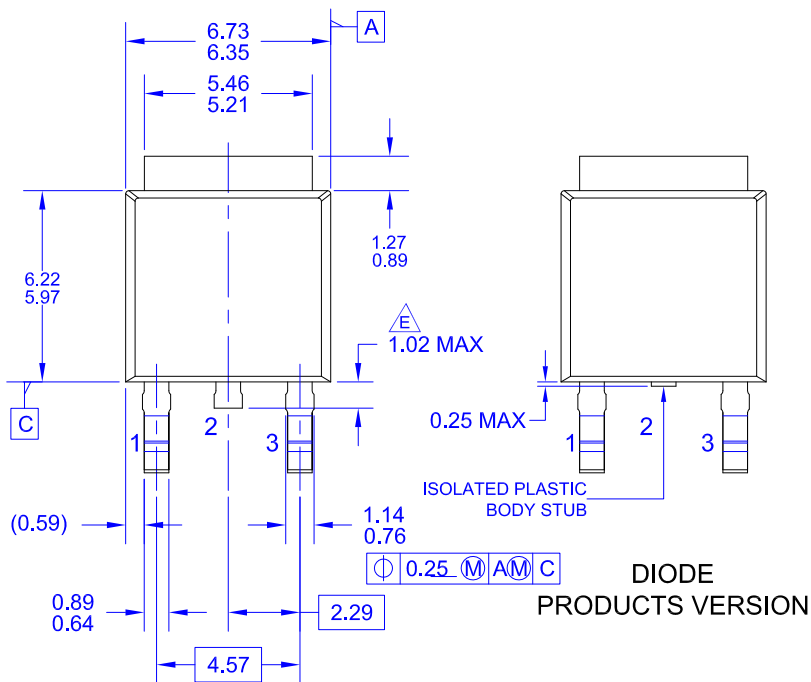
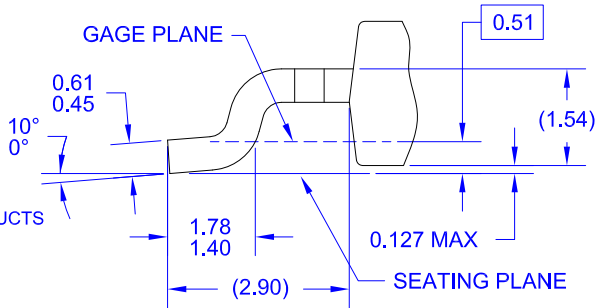


Figure 13. Transient Thermal Response Curve



NOTES: UNLESS OTHERWISE SPECIFIED

- A) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE C, VARIATION AA.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.
- D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION.
- E) TRIMMED METAL CENTER LEAD IS PRESENT ON FOR NON-DIODE PRODUCTS
- F) DIMENSIONS ARE EXCLUSIVE OF BURS, MOLD FLASH AND TIE BAR EXTRUSIONS.
- G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TO228P991X239-3N.
- H) DRAWING NUMBER AND REVISION: MKT-TO252A03REV11



DETAIL A  
(ROTATED -90°)  
SCALE: 12X





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| ESBC™                    | MicroPak2™                                     | STEALTH™                              | UniFET™          |
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| FACT Quiet Series™       | MTi®   | SuperSOT™-8                           | Xs™              |
| FACT®                    | MTx®   | SupreMOS®                             | Xsens™           |
| FastvCore™               | MVN®   | SyncFET™                              | 仙童®              |
| FETBench™                | mWSaver®                                       | Sync-Lock™                            |                  |
| FPS™                     | OptoHiT™                                       |                                       |                  |
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