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# FDMC7696

## N-Channel PowerTrench<sup>®</sup> MOSFET

30 V, 12 A, 11.5 mΩ

### Features

- Max  $r_{DS(on)}$  = 11.5 mΩ at  $V_{GS} = 10\text{ V}$ ,  $I_D = 12\text{ A}$
- Max  $r_{DS(on)}$  = 14.5 mΩ at  $V_{GS} = 4.5\text{ V}$ ,  $I_D = 10\text{ A}$
- High performance technology for extremely low  $r_{DS(on)}$
- Termination is Lead-free and RoHS Compliant

### General Description

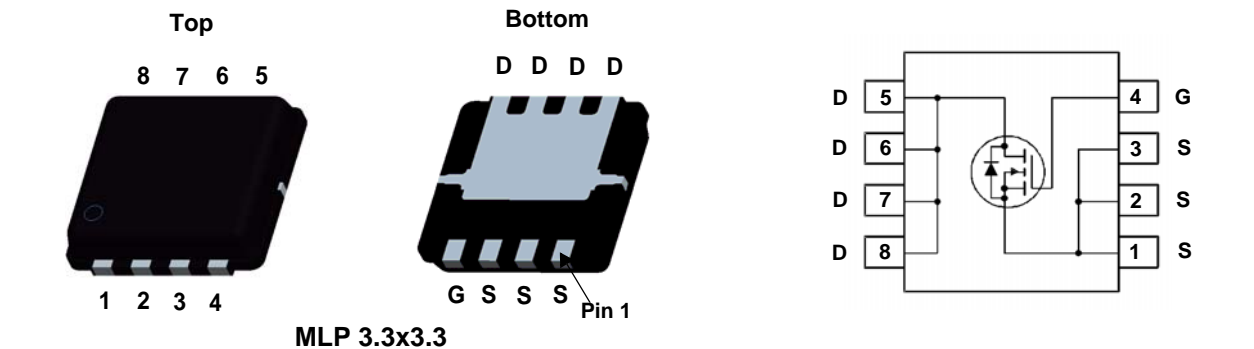
This N-Channel MOSFET is produced using Fairchild Semiconductor's advanced Power Trench<sup>®</sup> process that has been especially tailored to minimize the on-state resistance. This device is well suited for Power Management and load switching applications common in Notebook Computers and Portable Battery Packs.

### Applications

- DC/DC Buck Converters
- Notebook battery power management
- Load Switch in Notebook



FDMC7696 N-Channel PowerTrench<sup>®</sup> MOSFET



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

| Symbol         | Parameter  | Rated       | Units            |
|----------------|--|-------------|------------------|
| $V_{DS}$       | Drain to Source Voltage  | 30          | V                |
| $V_{DS(t)}$    | Drain to Source Transient Voltage ( $t_{\text{transient}} < 100\text{ ns}$ ) | 33          | V                |
| $V_{GS}$       | Gate to Source Voltage (Note 4)  | $\pm 20$    | V                |
| $I_D$          | Drain Current -Continuous (Package limited) $T_C = 25^\circ\text{C}$         | 20          | A                |
|                | -Continuous (Silicon limited) $T_C = 25^\circ\text{C}$                       | 38          |                  |
|                | -Continuous $T_A = 25^\circ\text{C}$ (Note 1a)                               | 12          |                  |
|                | -Pulsed  | 50          |                  |
| $E_{AS}$       | Single Pulse Avalanche Energy (Note 3)                                       | 21          | mJ               |
| $P_D$          | Power Dissipation $T_C = 25^\circ\text{C}$                                   | 25          | W                |
|                | Power Dissipation $T_A = 25^\circ\text{C}$ (Note 1a)                         | 2.4         |                  |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range                             | -55 to +150 | $^\circ\text{C}$ |

### Thermal Characteristics

|                 |   |     |                    |
|-----------------|---|-----|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case              | 5.0 | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1a) | 53  |                    |

### Package Marking and Ordering Information

| Device Marking | Device   | Package     | Reel Size | Tape Width | Quantity   |
|----------------|----------|-------------|-----------|------------|------------|
| FDMC7696       | FDMC7696 | MLP 3.3x3.3 | 13 "      | 12 mm      | 3000 units |

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

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

### Off Characteristics

|                                      |   |   |    |    |     |                      |
|--------------------------------------|---|---|----|----|-----|----------------------|
| $BV_{DSS}$                           | Drain to Source Breakdown Voltage         | $I_D = 250\text{ }\mu\text{A}, V_{GS} = 0\text{ V}$                       | 30 |    |     | V                    |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\text{ }\mu\text{A}$ , referenced to $25\text{ }^\circ\text{C}$ |    | 14 |     | mV/ $^\circ\text{C}$ |
| $I_{DSS}$                            | Zero Gate Voltage Drain Current           | $V_{DS} = 24\text{ V}, V_{GS} = 0\text{ V}$                               |    |    | 1   | $\mu\text{A}$        |
| $I_{GSS}$                            | Gate to Source Leakage Current, Forward   | $V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$                               |    |    | 100 | nA                   |

### On Characteristics

|  |  |  |     |      |      |                      |
|--|--|--|-----|------|------|----------------------|
| $V_{GS(th)}$                           | Gate to Source Threshold Voltage                         | $V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$                            | 1.2 | 2.0  | 3.0  | V                    |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D = 250\text{ }\mu\text{A}$ , referenced to $25\text{ }^\circ\text{C}$  |     | -6   |      | mV/ $^\circ\text{C}$ |
| $r_{DS(on)}$                           | Static Drain to Source On Resistance                     | $V_{GS} = 10\text{ V}, I_D = 12\text{ A}$                                  |     | 8.5  | 11.5 | m $\Omega$           |
|  |  | $V_{GS} = 4.5\text{ V}, I_D = 10\text{ A}$                                 |     | 11.5 | 14.5 |                      |
|  |  | $V_{GS} = 10\text{ V}, I_D = 12\text{ A}, T_J = 125\text{ }^\circ\text{C}$ |     | 11.6 | 15.7 |                      |
| $g_{FS}$                               | Forward Transconductance                                 | $V_{DS} = 5\text{ V}, I_D = 12\text{ A}$                                   |     | 45   |      | S                    |

### Dynamic Characteristics

|           |                              |   |     |      |      |          |
|-----------|------------------------------|---|-----|------|------|----------|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ |     | 1075 | 1430 | pF       |
| $C_{oss}$ | Output Capacitance           |   |     | 380  | 505  | pF       |
| $C_{rss}$ | Reverse Transfer Capacitance |   |     | 40   | 55   | pF       |
| $R_g$     | Gate Resistance              |   | 0.2 | 1.0  | 2.0  | $\Omega$ |

### Switching Characteristics

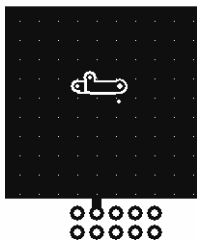
|              |                               |  |   |     |    |    |
|--------------|-------------------------------|--|---|-----|----|----|
| $t_{d(on)}$  | Turn-On Delay Time            | $V_{DD} = 15\text{ V}, I_D = 12\text{ A}, V_{GS} = 10\text{ V}, R_{GEN} = 6\text{ }\Omega$ |   | 9   | 18 | ns |
| $t_r$        | Rise Time                     |  |   | 2   | 10 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time           |  |   | 19  | 33 | ns |
| $t_f$        | Fall Time                     |  |   | 2   | 10 | ns |
| $Q_g$        | Total Gate Charge             |  | $V_{GS} = 0\text{ V to } 10\text{ V}$     |     | 16 | 22 |
| $Q_g$        | Total Gate Charge             | $V_{GS} = 0\text{ V to } 5\text{ V}$   | $V_{DD} = 15\text{ V}, I_D = 12\text{ A}$ | 8   | 11 | nC |
| $Q_{gs}$     | Gate to Source Charge         |  |   | 3.2 |    | nC |
| $Q_{gd}$     | Gate to Drain "Miller" Charge |  |   | 1.8 |    | nC |

### Drain-Source Diode Characteristics

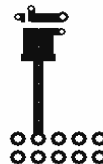
|          |                                       |   |  |      |     |    |
|----------|---------------------------------------|---|--|------|-----|----|
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS} = 0\text{ V}, I_S = 1.9\text{ A}$ (Note 2)    |  | 0.75 | 1.2 | V  |
|          |                                       | $V_{GS} = 0\text{ V}, I_S = 12\text{ A}$ (Note 2)     |  | 0.84 | 1.2 |    |
| $t_{rr}$ | Reverse Recovery Time                 | $I_F = 12\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$ |  | 25   | 40  | ns |
| $Q_{rr}$ | Reverse Recovery Charge               |   |  | 9    | 18  | nC |

#### Notes:

- $R_{\theta JA}$  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.  $53\text{ }^\circ\text{C/W}$  when mounted on a  $1\text{ in}^2$  pad of 2 oz copper.



b.  $125\text{ }^\circ\text{C/W}$  when mounted on a minimum pad of 2 oz copper.

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

3.  $E_{AS}$  of 21 mJ is based on starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 0.3\text{ mH}$ ,  $I_{AS} = 12\text{ A}$ ,  $V_{DD} = 27\text{ V}$ ,  $V_{GS} = 10\text{ V}$ .

4. As an N-ch device, the negative  $V_{GS}$  rating is for low duty cycle pulse occurrence only. No continuous rating is implied.

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

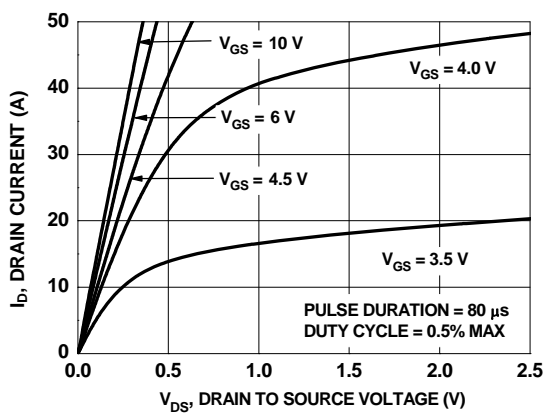


Figure 1. On Region Characteristics

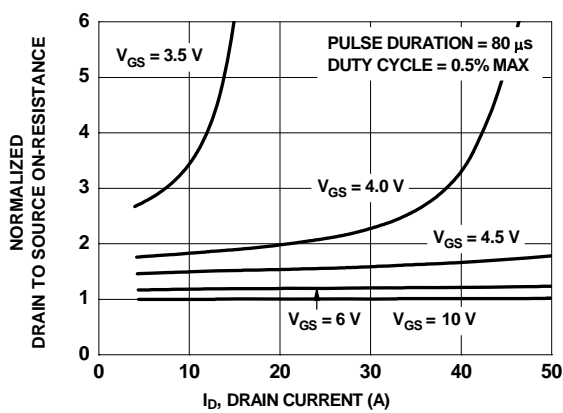


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

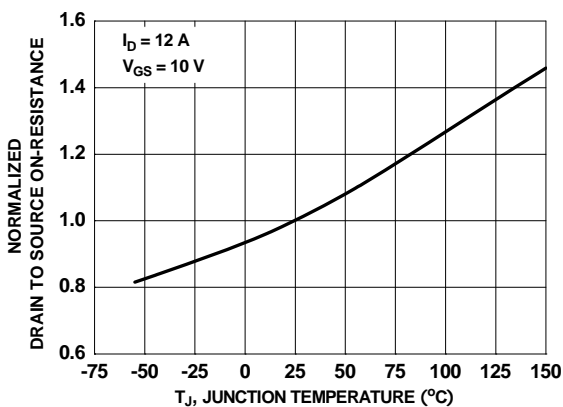


Figure 3. Normalized On Resistance vs Junction Temperature

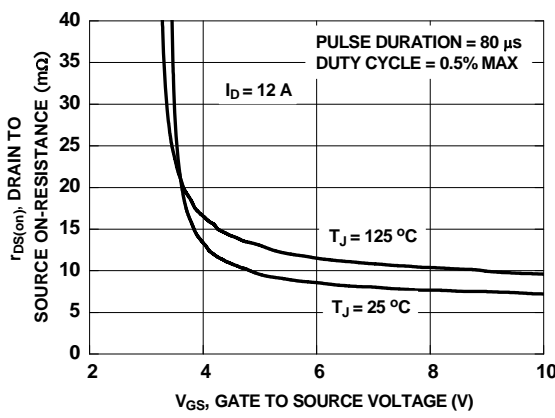


Figure 4. On-Resistance vs Gate to Source Voltage

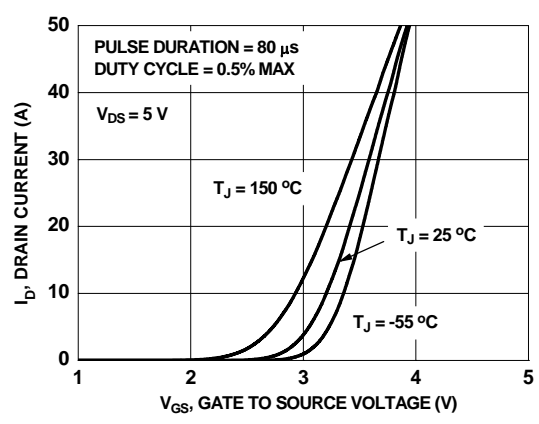


Figure 5. Transfer Characteristics

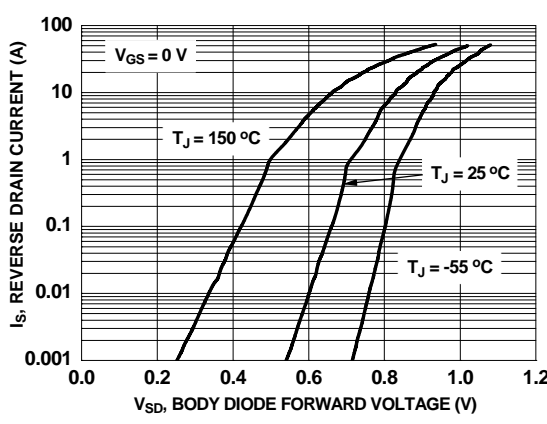
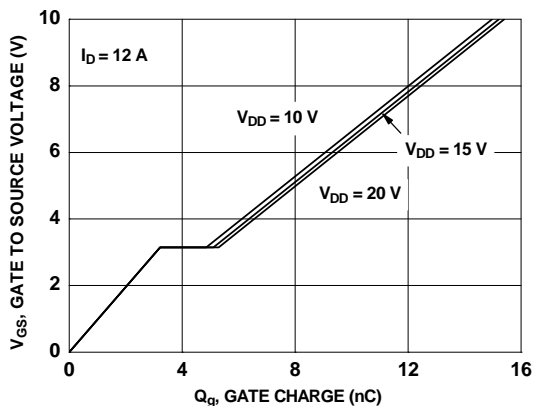
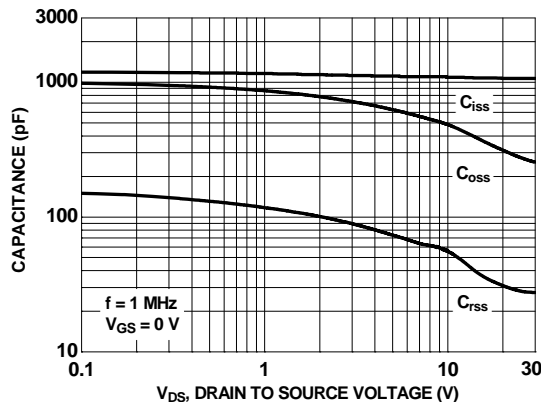


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

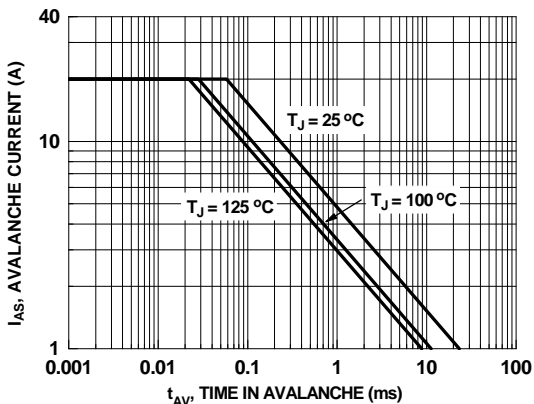
**Typical Characteristics**  $T_J = 25\text{ }^\circ\text{C}$  unless otherwise noted



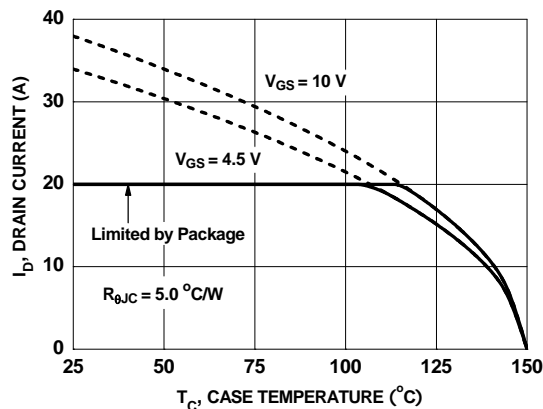
**Figure 7. Gate Charge Characteristics**



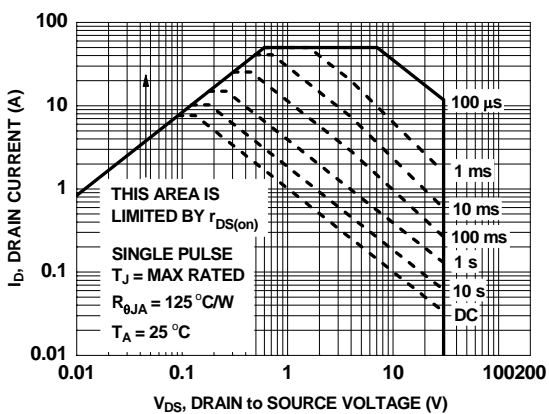
**Figure 8. Capacitance vs Drain to Source Voltage**



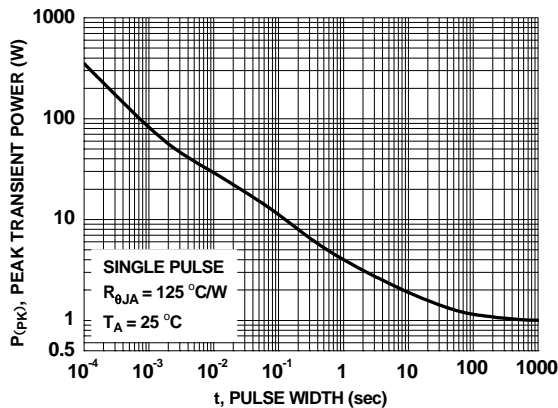
**Figure 9. Unclamped Inductive Switching Capability**



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

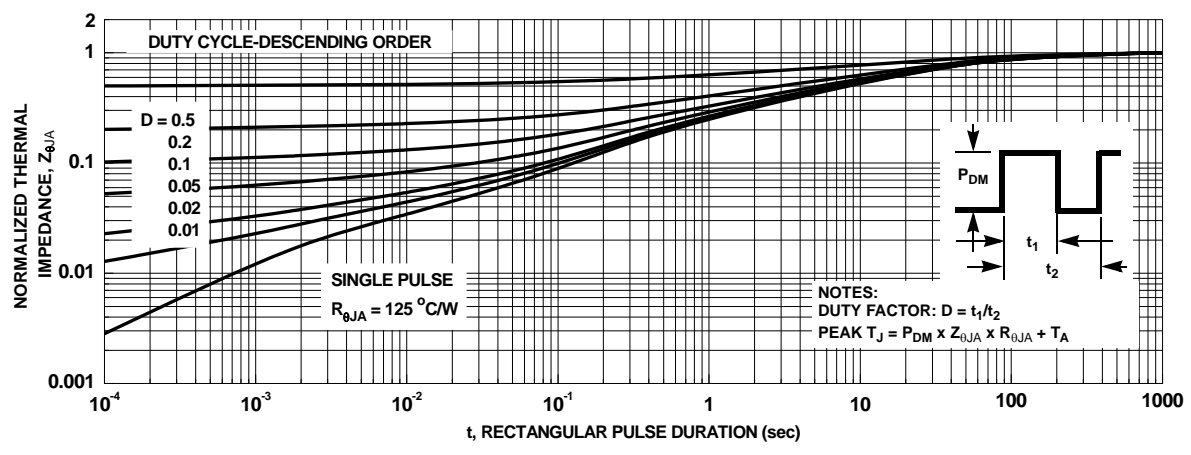


**Figure 11. Forward Bias Safe Operating Area**

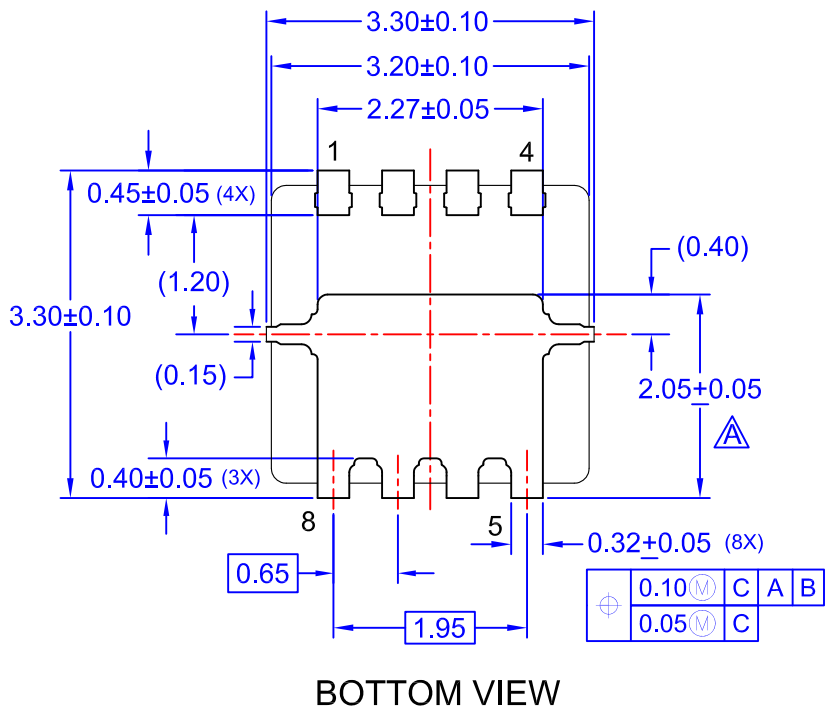
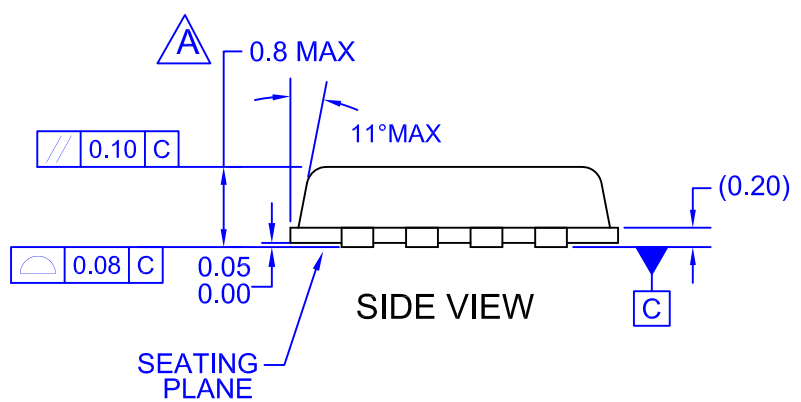
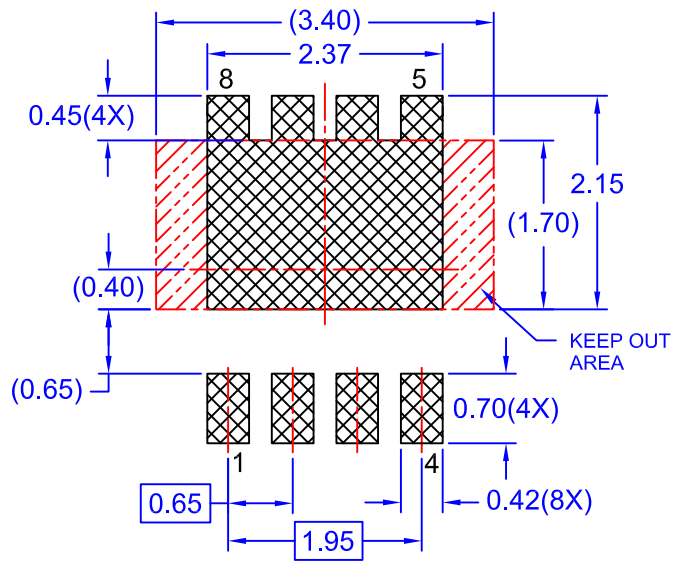
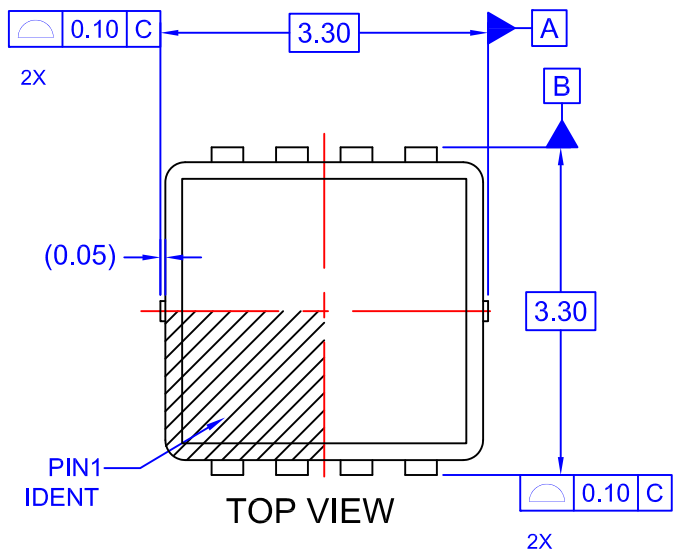


**Figure 12. Single Pulse Maximum Power Dissipation**

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



**Figure 13. Junction-to-Ambient Transient Thermal Response Curve**



- NOTES:**
- A. EXCEPT AS NOTED, PACKAGE CONFORMS TO JEDEC REGISTRATION MO-240 VARIATION BA.
  - B. DIMENSIONS ARE IN MILLIMETERS.
  - C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 2009.
  - D. SEATING PLANE IS DEFINED BY TERMINAL TIPS ONLY
  - E. BODY DIMENSIONS DO NOT INCLUDE MOLD FLASH PROTRUSIONS NOR GATE BURRS.
  - F. FLANGE DIMENSIONS INCLUDE INTERTERMINAL FLASH OR PROTRUSION. INTERTERMINAL FLASH OR PROTRUSION SHALL NOT EXCEED 0.25MM PER SIDE.
  - G. IT IS RECOMMENDED TO HAVE NO TRACES OR VIA WITHIN THE KEEP OUT AREA.
  - H. DRAWING FILENAME: MKT-MLP08Trev4.
  - I. GENERAL RADII FOR ALL CORNERS SHALL BE 0.20MM MAX.



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