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# FDMC013P030Z

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

-30 V, -54 A, 7.0 mΩ

### Features

- Max  $r_{DS(on)}$  = 7.0 mΩ at  $V_{GS} = -10$  V,  $I_D = -14$  A
- Max  $r_{DS(on)}$  = 12.0 mΩ at  $V_{GS} = -4.5$  V,  $I_D = -10$  A
- High Performance Trench Technology for Extremely Low  $r_{DS(on)}$
- High Power and Current Handling Capability in a Widely Used Surface Mount Package
- Termination is Lead-free and RoHS Compliant
- HBM ESD Capability Level > 4 kV Typical (Note 4)

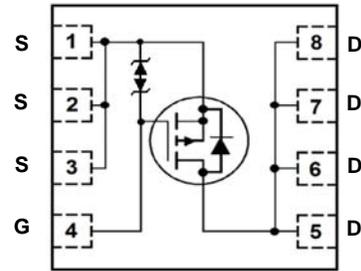
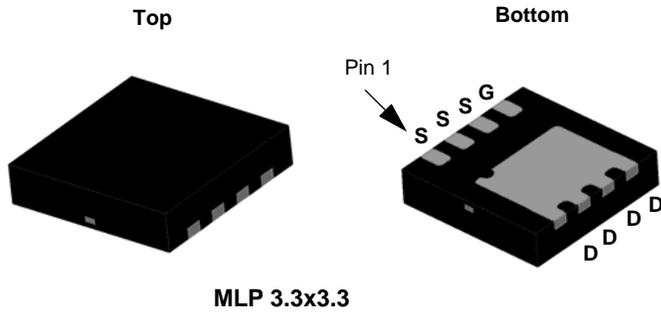


### General Description

This P-Channel MOSFET is produced using Fairchild Semiconductor's advanced PowerTrench process that has been optimized for  $r_{DS(on)}$ , switching performance and ruggedness.

### Applications

- Battery Management
- Load Switch



### MOSFET Maximum Ratings $T_A = 25$ °C unless otherwise noted.

| Symbol         | Parameter  | Ratings                 | Units |
|----------------|--|-------------------------|-------|
| $V_{DS}$       | Drain to Source Voltage                          | -30                     | V     |
| $V_{GS}$       | Gate to Source Voltage                           | ±25                     | V     |
| $I_D$          | Drain Current -Continuous                        | $T_C = 25$ °C (Note 5)  | -54   |
|                | Drain Current -Continuous                        | $T_C = 100$ °C (Note 5) | -35   |
|                | -Continuous                                      | $T_A = 25$ °C (Note 1a) | -14   |
|                | -Pulsed  | (Note 4)                | -309  |
| $E_{AS}$       | Single Pulse Avalanche Energy                    | (Note 3)                | 54    |
| $P_D$          | Power Dissipation                                | $T_C = 25$ °C           | 30    |
|                | Power Dissipation                                | $T_A = 25$ °C (Note 1a) | 2.4   |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range | -55 to +150             | °C    |

### Thermal Characteristics

|                 |   |     |      |
|-----------------|---|-----|------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case              | 4.2 | °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   |
|----------------|--------------|-------------|-----------|------------|------------|
| FDMC013P030Z   | FDMC013P030Z | MLP 3.3x3.3 | 13 "      | 12 mm      | 3000 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         | $I_D = -250\ \mu\text{A}, V_{GS} = 0\ \text{V}$              | -30 |     |          | V                    |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = -250\ \mu\text{A}$ , referenced to $25^\circ\text{C}$ |     | -13 |          | 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            | $V_{GS} = \pm 25\ \text{V}, V_{DS} = 0\ \text{V}$            |     |     | $\pm 10$ | $\mu\text{A}$        |

### On Characteristics

|  |  |  |    |      |      |                      |
|--|--|--|----|------|------|----------------------|
| $V_{GS(th)}$                           | Gate to Source Threshold Voltage                         | $V_{GS} = V_{DS}, I_D = -250\ \mu\text{A}$                             | -1 | -1.6 | -3   | 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    |      | mV/ $^\circ\text{C}$ |
| $r_{DS(on)}$                           | Static Drain to Source On Resistance                     | $V_{GS} = -10\ \text{V}, I_D = -14\ \text{A}$                          |    | 5.0  | 7.0  | m $\Omega$           |
|  |  | $V_{GS} = -4.5\ \text{V}, I_D = -10\ \text{A}$                         |    | 8.0  | 12.0 |                      |
|  |  | $V_{GS} = -10\ \text{V}, I_D = -14\ \text{A}, T_J = 125^\circ\text{C}$ |    | 6.2  | 10.4 |                      |
| $g_{FS}$                               | Forward Transconductance                                 | $V_{DS} = -5\ \text{V}, I_D = -14\ \text{A}$                           |    | 60   |      | S                    |

### Dynamic Characteristics

|           |                              |   |  |      |      |    |
|-----------|------------------------------|---|--|------|------|----|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = -15\ \text{V}, V_{GS} = 0\ \text{V}, f = 1\ \text{MHz}$ |  | 4130 | 5785 | pF |
| $C_{oss}$ | Output Capacitance           |   |  | 1355 | 1895 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance |   |  | 1335 | 1870 | pF |

### Switching Characteristics

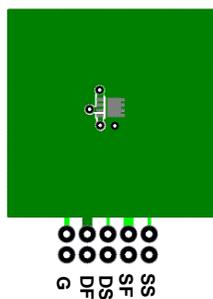
|              |                               |   |   |     |     |     |    |
|--------------|-------------------------------|---|---|-----|-----|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time            | $V_{DD} = -15\ \text{V}, I_D = -14\ \text{A}, V_{GS} = -4.5\ \text{V}, R_{GEN} = 6\ \Omega$ |   | 34  | 55  | ns  |    |
| $t_r$        | Rise Time                     |   |   | 157 | 251 | ns  |    |
| $t_{d(off)}$ | Turn-Off Delay Time           |   |   | 55  | 88  | ns  |    |
| $t_f$        | Fall Time                     |   |   | 94  | 150 | ns  |    |
| $Q_g$        | Total Gate Charge             |   | $V_{GS} = 0\ \text{V to } -10\ \text{V}$      |     | 96  | 135 | nC |
| $Q_g$        | Total Gate Charge             | $V_{GS} = 0\ \text{V to } -4.5\ \text{V}$   | $V_{DD} = -15\ \text{V}, I_D = -14\ \text{A}$ |     | 58  | 81  | nC |
| $Q_{gs}$     | Gate to Source Charge         |   |   |     | 11  |     | nC |
| $Q_{gd}$     | Gate to Drain "Miller" Charge |   |   |     | 36  |     | nC |

### Drain-Source Diode Characteristics

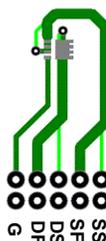
|          |                                       |  |  |      |      |    |
|----------|---------------------------------------|--|--|------|------|----|
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS} = 0\ \text{V}, I_S = -14\ \text{A}$ (Note 2)     |  | -0.8 | -1.3 | V  |
|          |                                       | $V_{GS} = 0\ \text{V}, I_S = -2\ \text{A}$ (Note 2)      |  | -0.7 | -1.2 |    |
| $t_{rr}$ | Reverse Recovery Time                 | $I_F = -14\ \text{A}, di/dt = 100\ \text{A}/\mu\text{s}$ |  | 44   | 77   | ns |
| $Q_{rr}$ | Reverse Recovery Charge               |  |  | 23   | 37   | 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.  $R_{\theta CA}$  is determined by the user's board design.



a)  $53^\circ\text{C}/\text{W}$  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.  $E_{AS}$  of 54 mJ is based on starting  $T_J = 25^\circ\text{C}$ ,  $L = 3\ \text{mH}$ ,  $I_{AS} = 6\ \text{A}$ ,  $V_{DD} = 30\ \text{V}$ ,  $V_{GS} = 10\ \text{V}$ .

4. Pulsed Id please refer to Fig 11 SOA graph for more details.

5. Computed continuous current limited to Max Junction Temperature only, actual continuous current will be limited by thermal & electro-mechanical application board design.

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

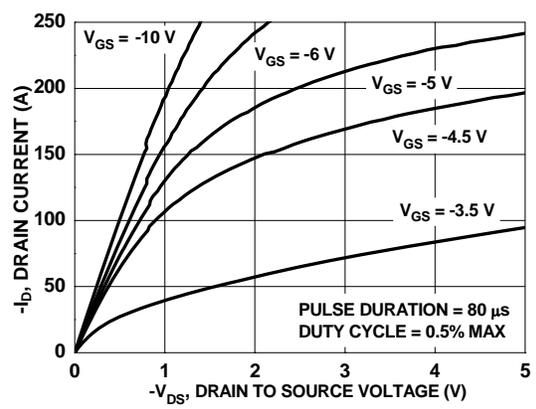


Figure 1. On Region Characteristics

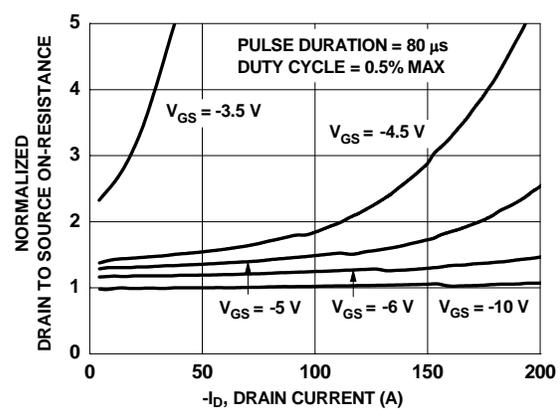


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

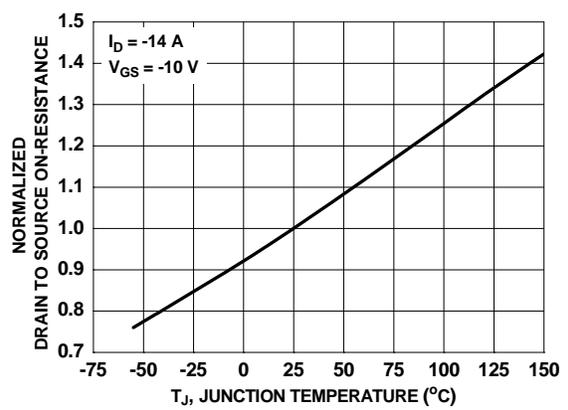


Figure 3. Normalized On Resistance vs. Junction Temperature

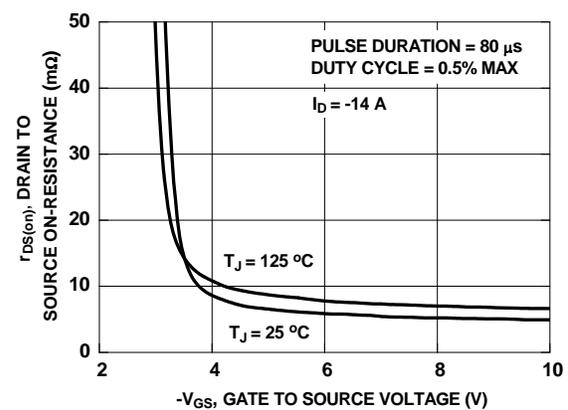


Figure 4. On-Resistance vs. Gate to Source Voltage

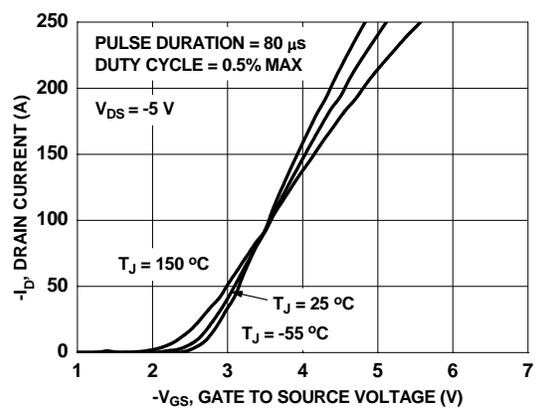


Figure 5. Transfer Characteristics

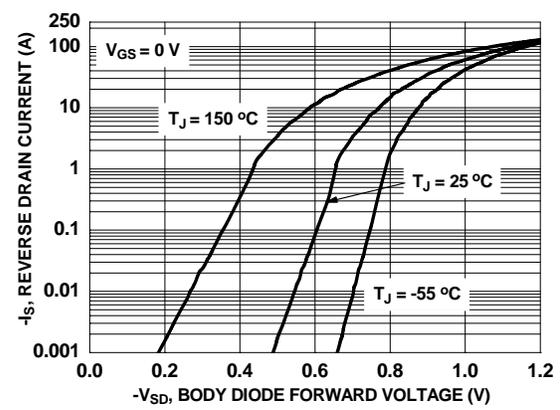
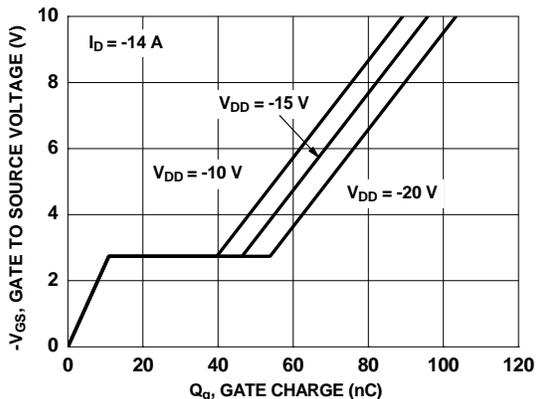
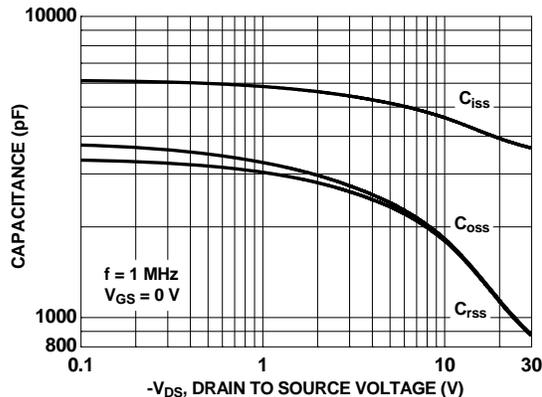


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

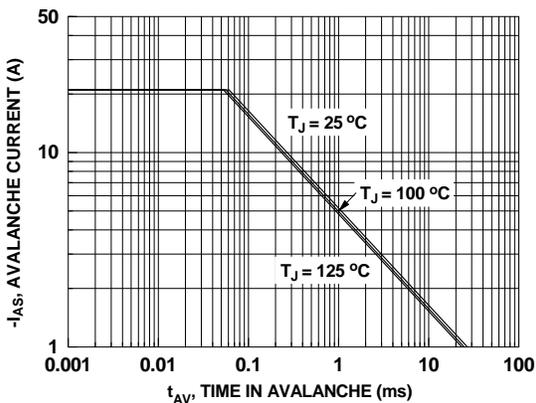
**Typical Characteristics**  $T_J = 25\text{ }^\circ\text{C}$  unless otherwise noted.



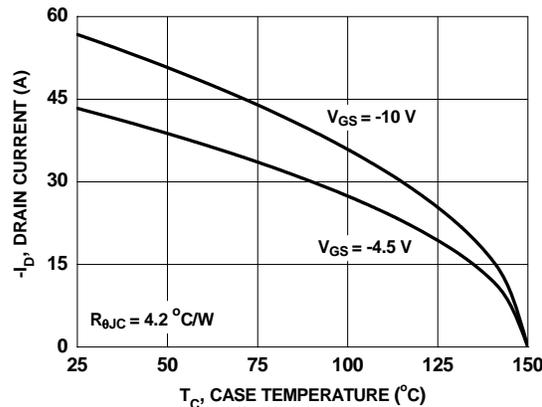
**Figure 7. Gate Charge Characteristics**



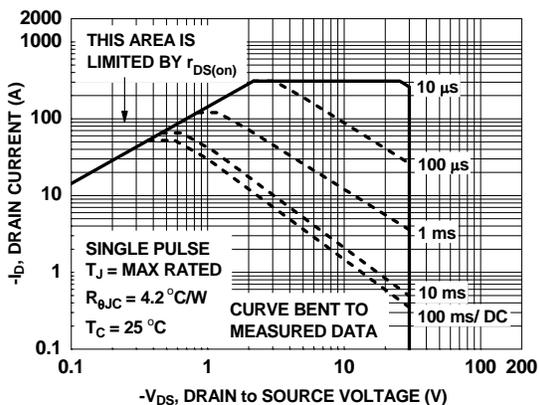
**Figure 8. Capacitance vs. Drain to Source Voltage**



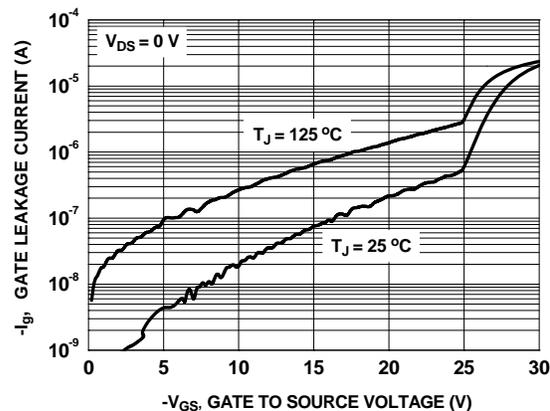
**Figure 9. Unclamped Inductive Switching Capability**



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



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



**Figure 12.  $I_{gss}$  vs.  $V_{gss}$**

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

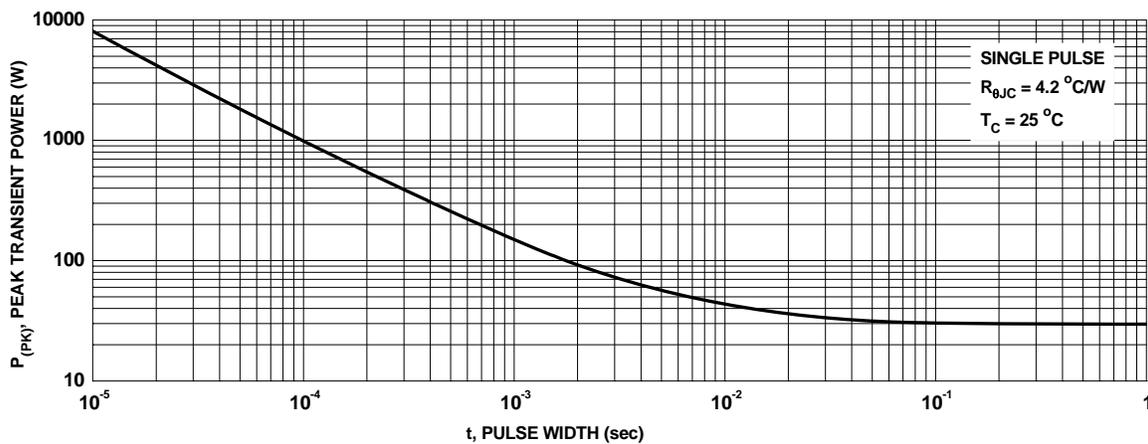


Figure 13. Single Pulse Maximum Power Dissipation

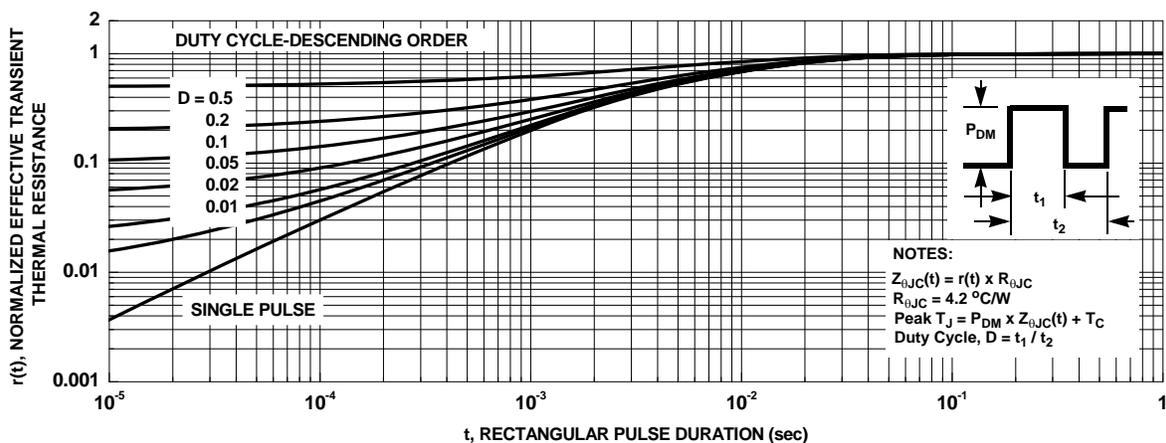
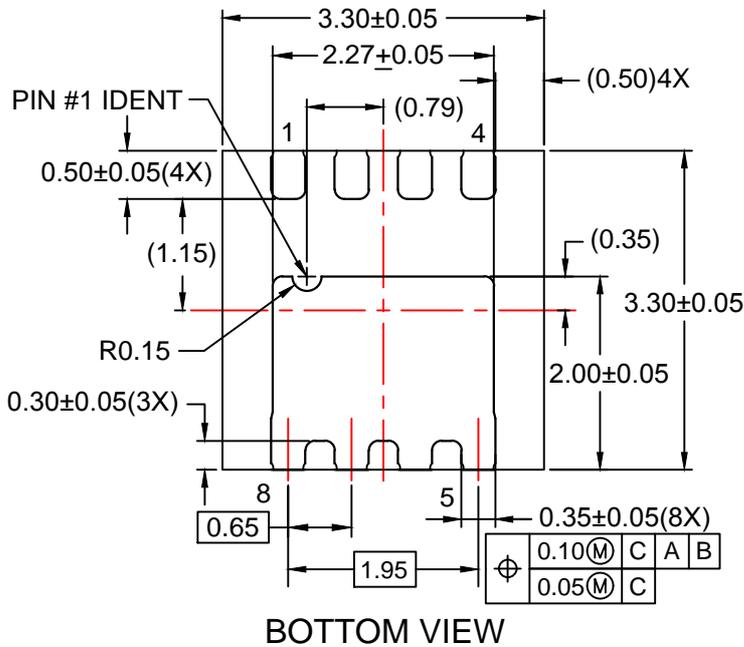
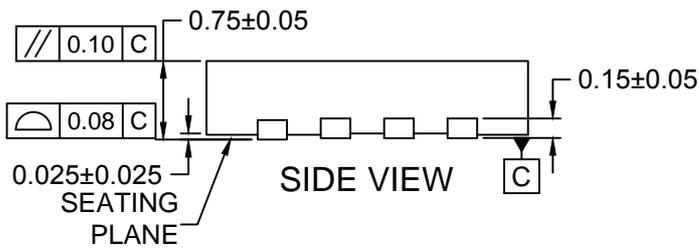
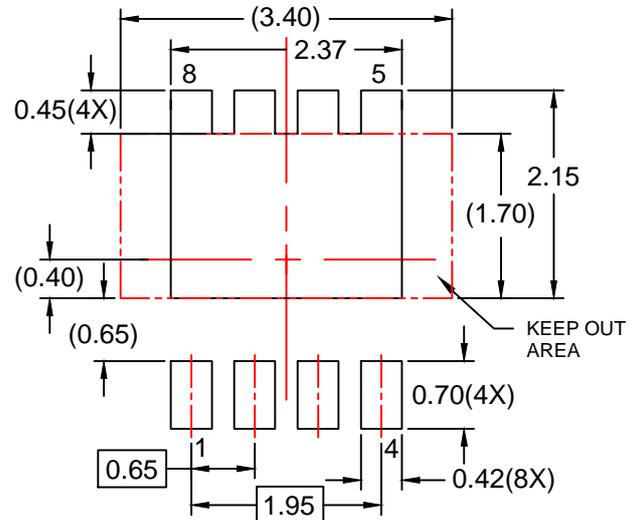
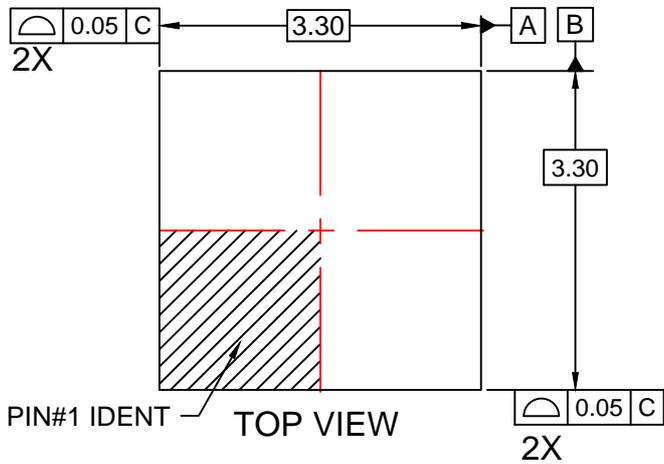


Figure 14. Junction to Case Transient Thermal Response Curve



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