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July 2015

# FDMS86200DC

## N-Channel Dual Cool™ 56 Shielded Gate PowerTrench® MOSFET 150 V, 40 A, 17 mΩ

### Features

- Shielded Gate MOSFET Technology
- Dual Cool™ Top Side Cooling PQFN package
- Max  $r_{DS(on)}$  = 17 mΩ at  $V_{GS} = 10$  V,  $I_D = 9.3$  A
- Max  $r_{DS(on)}$  = 25 mΩ at  $V_{GS} = 6$  V,  $I_D = 7.8$  A
- High performance technology for extremely low  $r_{DS(on)}$
- 100% UIL tested
- RoHS Compliant

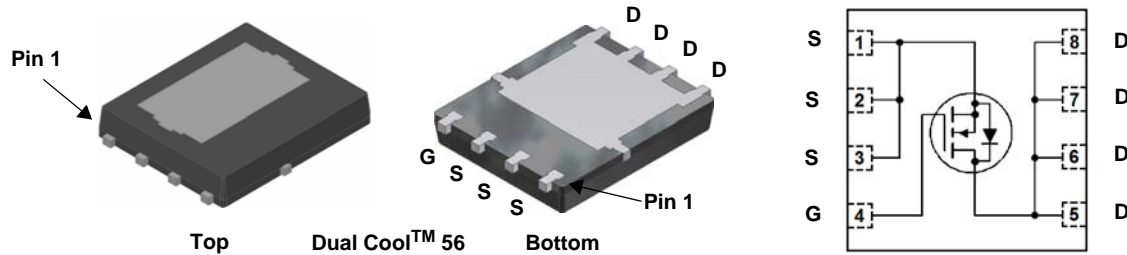


### General Description

This N-Channel MOSFET is produced using Fairchild Semiconductor's advanced PowerTrench® process that incorporates Shielded Gate technology. Advancements in both silicon and Dual Cool™ package technologies have been combined to offer the lowest  $r_{DS(on)}$  while maintaining excellent switching performance by extremely low Junction-to-Ambient thermal resistance.

### Applications

- Primary MOSFET in DC - DC converters
- Secondary Synchronous rectifier
- Load switch



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

| Symbol         | Parameter  | Ratings                 | Units |
|----------------|--|-------------------------|-------|
| $V_{DS}$       | Drain to Source Voltage                          | 150                     | V     |
| $V_{GS}$       | Gate to Source Voltage                           | ±20                     | V     |
| $I_D$          | Drain Current -Continuous                        | $T_C = 25$ °C           | 40    |
|                | -Continuous                                      | $T_A = 25$ °C (Note 1a) | 9.3   |
|                | -Pulsed  | (Note 4)                | 100   |
| $E_{AS}$       | Single Pulse Avalanche Energy                    | (Note 3)                | 294   |
| $P_D$          | Power Dissipation                                | $T_C = 25$ °C           | 125   |
|                | Power Dissipation                                | $T_A = 25$ °C (Note 1a) | 3.2   |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range | -55 to +150             | °C    |

### Thermal Characteristics

|                 |   |                |     |      |
|-----------------|---|----------------|-----|------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case    | (Top Source)   | 2.5 | °C/W |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case    | (Bottom Drain) | 1.0 |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1a)      | 38  |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1b)      | 81  |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1i)      | 16  |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1j)      | 23  |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1k)      | 11  |      |

### Package Marking and Ordering Information

| Device Marking | Device      | Package       | Reel Size | Tape Width | Quantity   |
|----------------|-------------|---------------|-----------|------------|------------|
| 86200          | FDMS86200DC | Dual Cool™ 56 | 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         | $I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0\text{ V}$                    | 150 |     |           | V                    |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\text{ }\mu\text{A}$ , referenced to $25\text{ }^\circ\text{C}$ |     | 105 |           | mV/ $^\circ\text{C}$ |
| $I_{DSS}$                            | Zero Gate Voltage Drain Current           | $V_{DS} = 120\text{ V}$ , $V_{GS} = 0\text{ V}$                           |     |     | 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                         | $V_{GS} = V_{DS}$ , $I_D = 250\text{ }\mu\text{A}$                                | 2.0 | 3.3 | 4.0 | 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 $25\text{ }^\circ\text{C}$         |     | -11 |     | mV/ $^\circ\text{C}$ |
| $r_{DS(on)}$                           | Static Drain to Source On Resistance                     | $V_{GS} = 10\text{ V}$ , $I_D = 9.3\text{ A}$                                     |     | 14  | 17  | m $\Omega$           |
|  |  | $V_{GS} = 6\text{ V}$ , $I_D = 7.8\text{ A}$                                      |     | 17  | 25  |                      |
|  |  | $V_{GS} = 10\text{ V}$ , $I_D = 9.3\text{ A}$ , $T_J = 125\text{ }^\circ\text{C}$ |     | 29  | 35  |                      |
| $g_{FS}$                               | Forward Transconductance                                 | $V_{DS} = 10\text{ V}$ , $I_D = 9.3\text{ A}$                                     |     | 32  |     | S                    |

**Dynamic Characteristics**

|           |                              |  |     |      |      |          |
|-----------|------------------------------|--|-----|------|------|----------|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = 75\text{ V}$ , $V_{GS} = 0\text{ V}$ ,<br>$f = 1\text{ MHz}$ |     | 2110 | 2955 | pF       |
| $C_{oss}$ | Output Capacitance           |  |     | 205  | 290  | pF       |
| $C_{rss}$ | Reverse Transfer Capacitance |  |     | 8.1  | 15   | pF       |
| $R_g$     | Gate Resistance              |  | 0.1 | 1.5  | 3.0  | $\Omega$ |

**Switching Characteristics**

|              |                               |   |  |     |    |    |
|--------------|-------------------------------|---|--|-----|----|----|
| $t_{d(on)}$  | Turn-On Delay Time            | $V_{DD} = 75\text{ V}$ , $I_D = 9.3\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$ , $R_{GEN} = 6\text{ }\Omega$ |  | 16  | 29 | ns |
| $t_r$        | Rise Time                     |   |  | 4   | 10 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time           |   |  | 23  | 37 | ns |
| $t_f$        | Fall Time                     |   |  | 5   | 10 | ns |
| $Q_{g(TOT)}$ | Total Gate Charge             |   | $V_{GS} = 0\text{ V to }10\text{ V}$           |     | 30 | 42 |
|              | Total Gate Charge             | $V_{GS} = 0\text{ V to }6\text{ V}$   | $V_{DD} = 75\text{ V}$<br>$I_D = 9.3\text{ A}$ | 19  | 27 | nC |
| $Q_{gs}$     | Gate to Source Charge         |   |  | 9.7 |    | nC |
| $Q_{gd}$     | Gate to Drain "Miller" Charge |   |  | 5.6 |    | nC |

**Drain-Source Diode Characteristics**

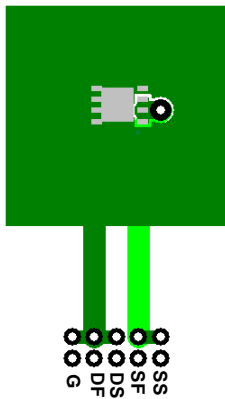
|          |                                       |   |  |     |     |    |
|----------|---------------------------------------|---|--|-----|-----|----|
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS} = 0\text{ V}$ , $I_S = 9.3\text{ A}$ (Note 2)     |  | 0.8 | 1.3 | V  |
|          |                                       | $V_{GS} = 0\text{ V}$ , $I_S = 2.6\text{ A}$ (Note 2)     |  | 0.7 | 1.2 |    |
| $t_{rr}$ | Reverse Recovery Time                 | $I_F = 9.3\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ |  | 79  | 126 | ns |
| $Q_{rr}$ | Reverse Recovery Charge               |   |  | 126 | 176 | nC |

## Thermal Characteristics

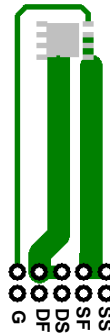
|                 |   |     |                             |
|-----------------|---|-----|-----------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case (Top Source)   | 2.5 | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case (Bottom Drain) | 1.0 |                             |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1a)   | 38  |                             |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1b)   | 81  |                             |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1c)   | 27  |                             |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1d)   | 34  |                             |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1e)   | 16  |                             |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1f)   | 19  |                             |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1g)   | 26  |                             |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1h)   | 61  |                             |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1i)   | 16  |                             |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1j)   | 23  |                             |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1k)   | 11  |                             |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1l)   | 13  |                             |

### NOTES:

- $R_{\theta JA}$  is determined with the device mounted on a FR-4 board using a specified pad of 2 oz copper as shown below.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a. 38  $^{\circ}\text{C}/\text{W}$  when mounted on a 1 in<sup>2</sup> pad of 2 oz copper



b. 81  $^{\circ}\text{C}/\text{W}$  when mounted on a minimum pad of 2 oz copper

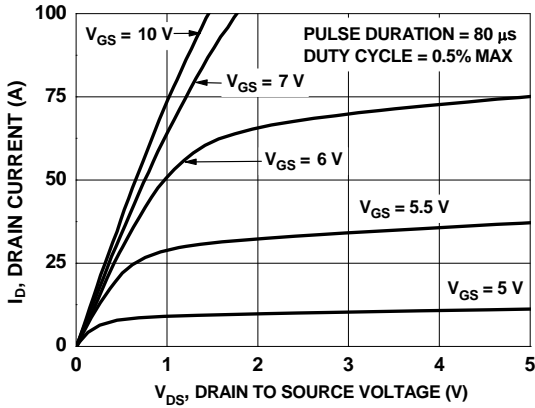
- Still air, 20.9x10.4x12.7mm Aluminum Heat Sink, 1 in<sup>2</sup> pad of 2 oz copper
- Still air, 20.9x10.4x12.7mm Aluminum Heat Sink, minimum pad of 2 oz copper
- Still air, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, 1 in<sup>2</sup> pad of 2 oz copper
- Still air, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, minimum pad of 2 oz copper
- 200FPM Airflow, No Heat Sink, 1 in<sup>2</sup> pad of 2 oz copper
- 200FPM Airflow, No Heat Sink, minimum pad of 2 oz copper
- 200FPM Airflow, 20.9x10.4x12.7mm Aluminum Heat Sink, 1 in<sup>2</sup> pad of 2 oz copper
- 200FPM Airflow, 20.9x10.4x12.7mm Aluminum Heat Sink, minimum pad of 2 oz copper
- 200FPM Airflow, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, 1 in<sup>2</sup> pad of 2 oz copper
- 200FPM Airflow, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, minimum pad of 2 oz copper

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

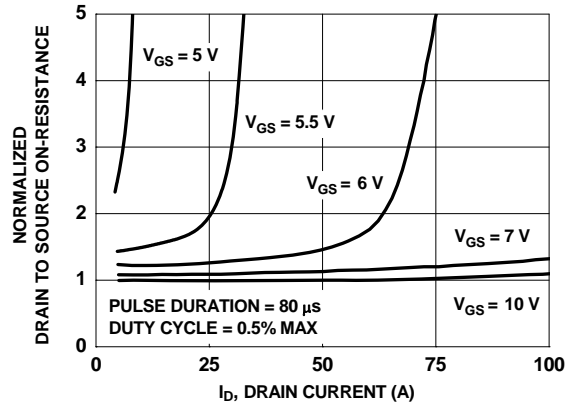
- $E_{AS}$  of 294 mJ is based on starting  $T_J = 25^{\circ}\text{C}$ ; N-ch:  $L = 3\text{ mH}$ ,  $I_{AS} = 14\text{ A}$ ,  $V_{DD} = 150\text{ V}$ ,  $V_{GS} = 10\text{ V}$ . 100% test at  $L = 0.1\text{ mH}$ ,  $I_{AS} = 42\text{ A}$ .

- Pulsed Id limited by junction temperature,  $t_d \leq 10\mu\text{s}$ , please refer to SOA curve for more details.

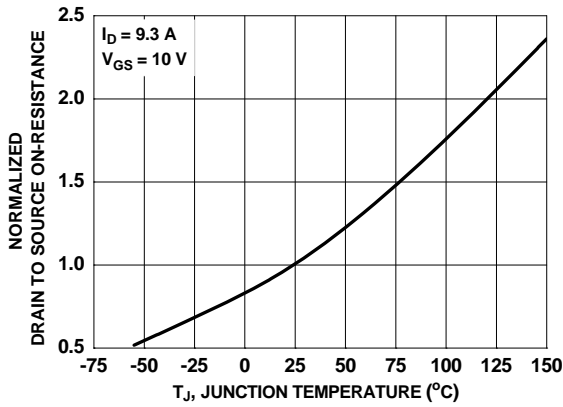
**Typical Characteristics**  $T_J = 25\text{ }^\circ\text{C}$  unless otherwise noted



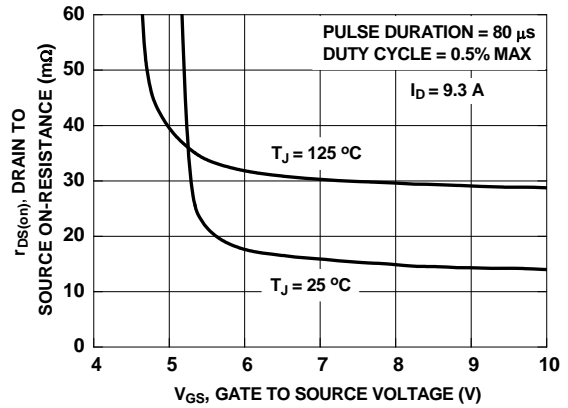
**Figure 1. On-Region Characteristics**



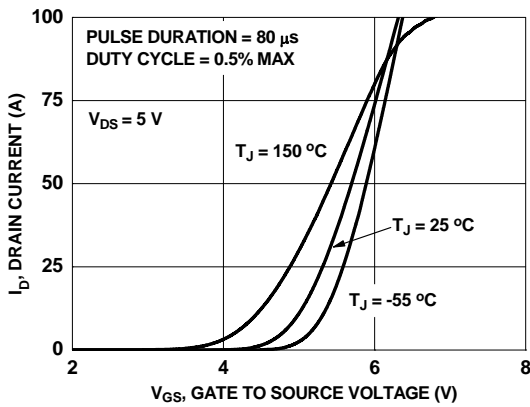
**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**



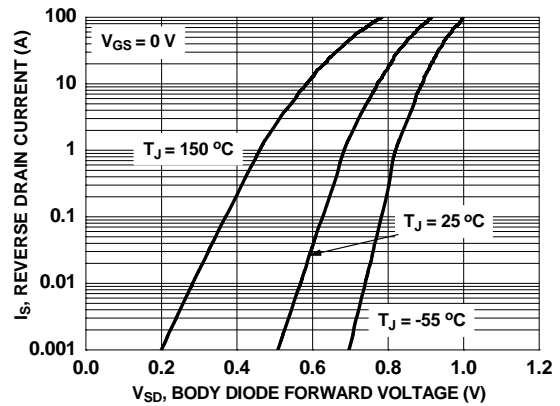
**Figure 3. Normalized On-Resistance vs Junction Temperature**



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

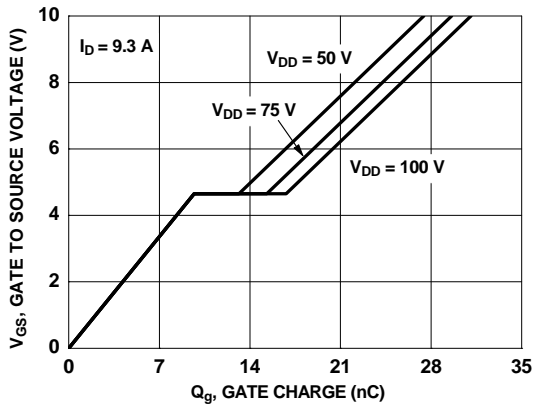


**Figure 5. Transfer Characteristics**

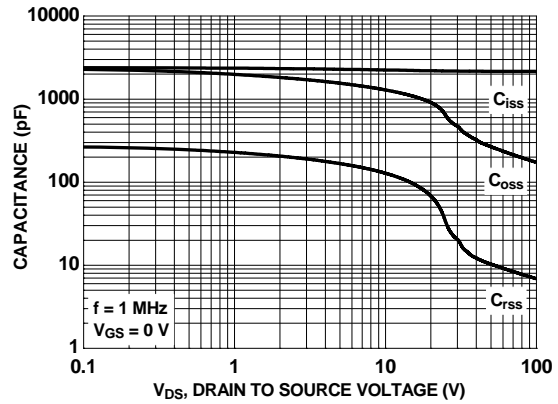


**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

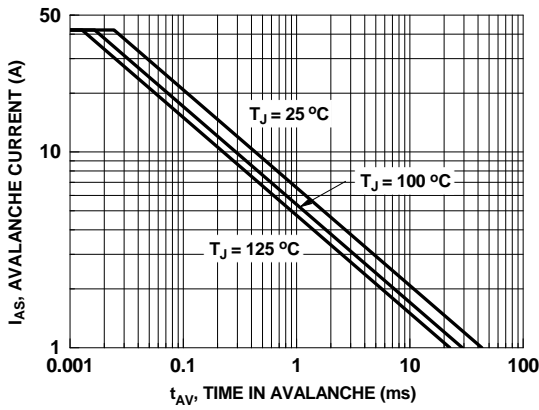
**Typical Characteristics**  $T_J = 25\text{ }^\circ\text{C}$  unless otherwise noted



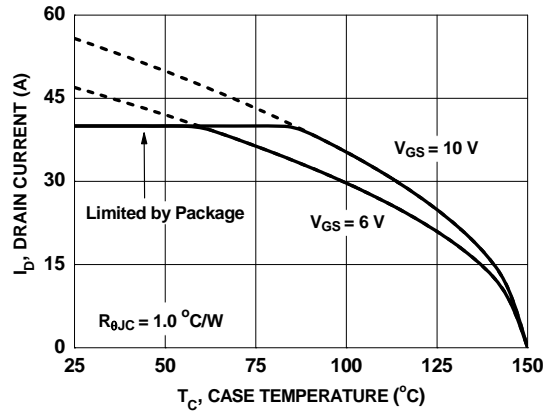
**Figure 7. Gate Charge Characteristics**



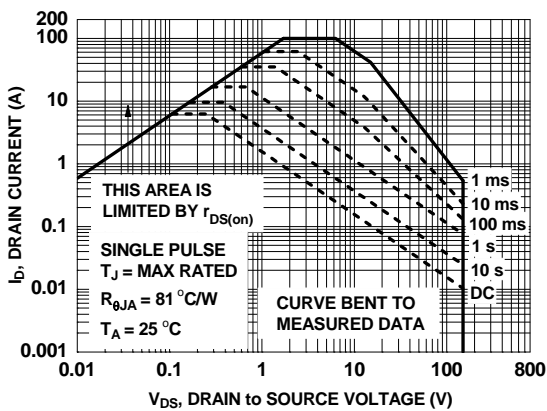
**Figure 8. Capacitance vs Drain to Source Voltage**



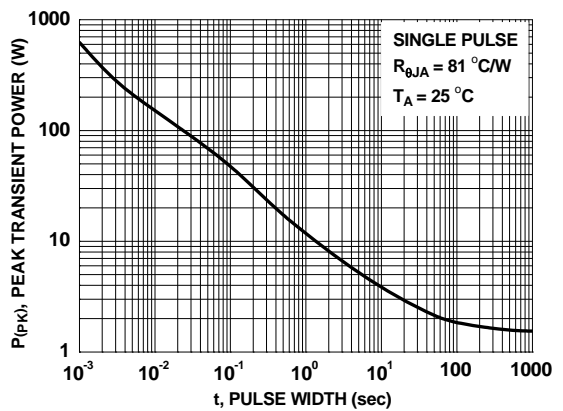
**Figure 9. Unclamped Inductive Switching Capability**



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

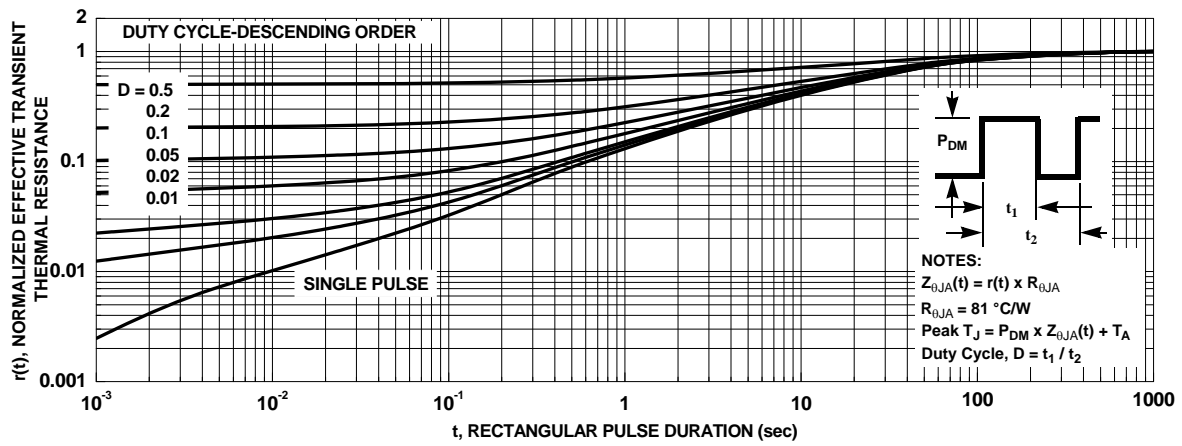


**Figure 11. Forward Bias Safe Operating Area**

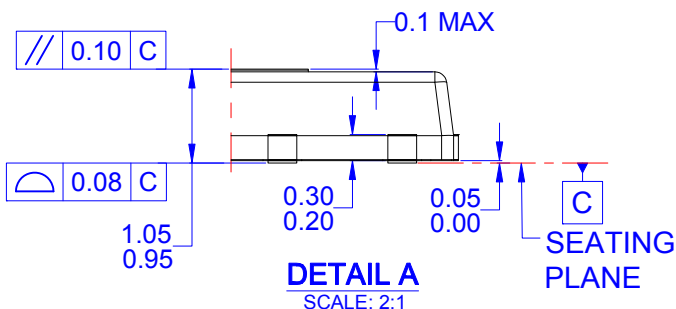
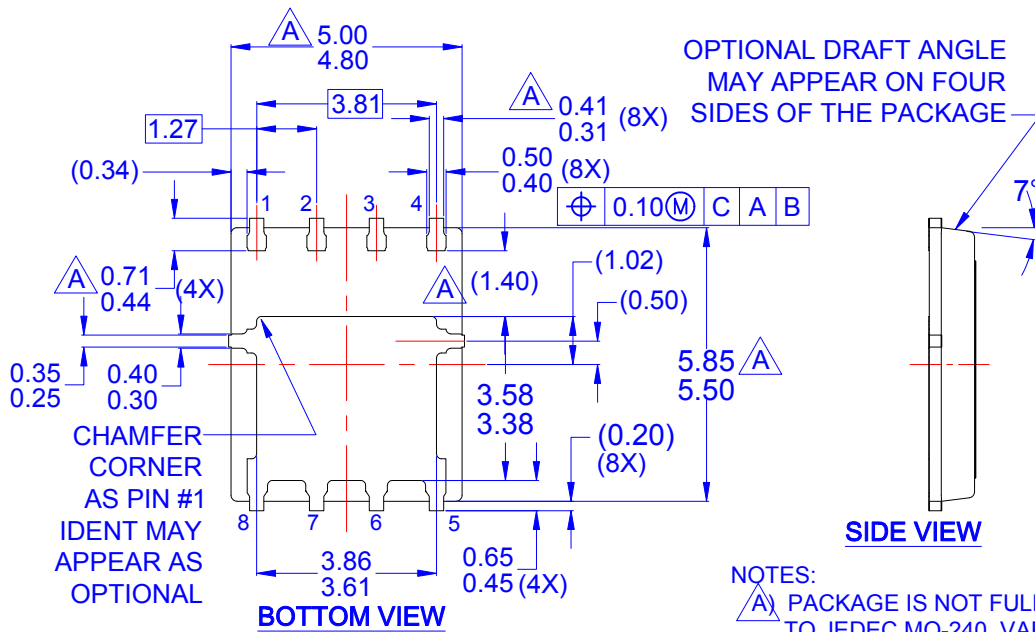
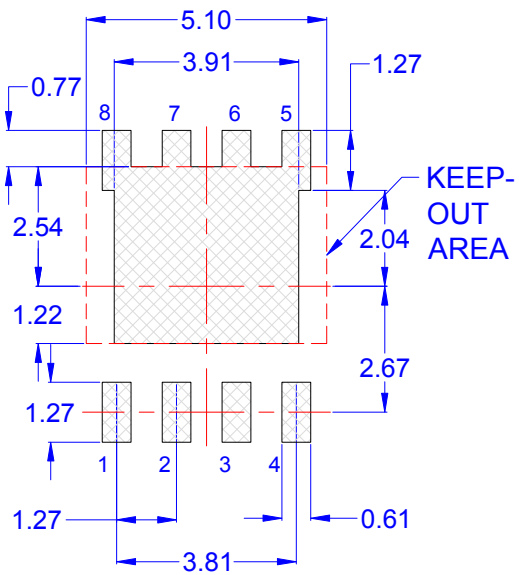
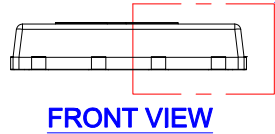
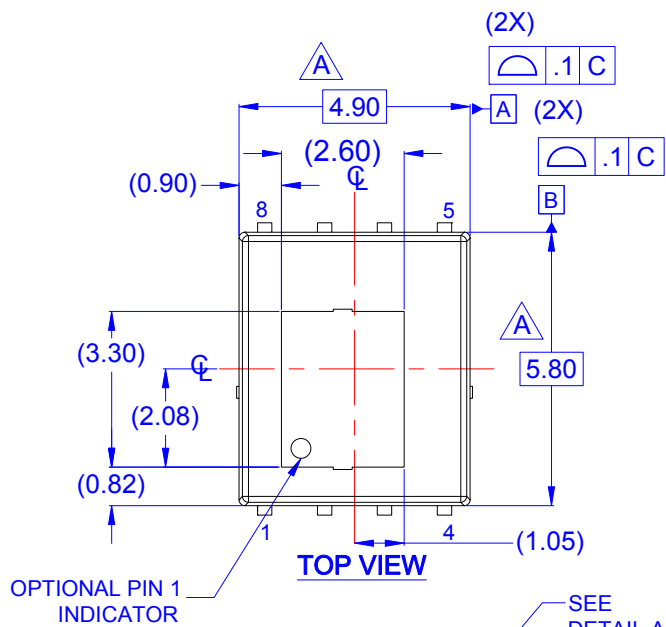


**Figure 12. Single Pulse Maximum Power Dissipation**

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



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



- NOTES:
- A) PACKAGE IS NOT FULLY COMPLIANT TO JEDEC MO-240, VARIATION AA.
  - B) ALL DIMENSIONS ARE IN MILLIMETERS.
  - C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH. MOLD FLASH OR BURRS DOES NOT EXCEED 0.10MM.
  - D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.
  - E) IT IS RECOMMENDED TO HAVE NO TRACES OR VIAS WITHIN THE KEEP OUT AREA.
  - F) DRAWING FILE NAME: PQFN08DREV4





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