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FAIRCHILD

July 2015

# FDMS86500DC

## N-Channel Dual Cool™ 56 Power Trench® MOSFET

**60 V, 108 A, 2.3 mΩ**

### Features

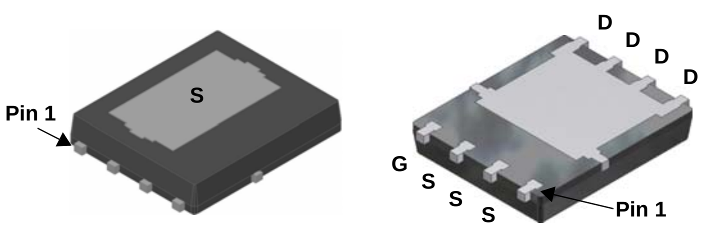
- Dual Cool™ Top Side Cooling PQFN package
- Max $r_{DS(on)}$ = 2.3 mΩ at $V_{GS}$ = 10 V, $I_D$ = 29 A
- Max $r_{DS(on)}$ = 3.3 mΩ at $V_{GS}$ = 8 V, $I_D$ = 24 A
- High performance technology for extremely low $r_{DS(on)}$
- 100% UIL Tested
- RoHS Compliant

### General Description

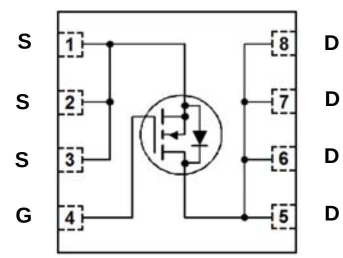
This N-Channel MOSFET is produced using Fairchild Semiconductor's advanced Power Trench® process. Advancements in both silicon and Dual Cool™ package technologies have been combined to offer the lowest $r_{DS(on)}$ while maintaining excellent switching performance by extremely low Junction-to-Ambient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

### Applications

- Synchronous Rectifier for DC/DC Converters
- Telecom Secondary Side Rectification
- High End Server/Workstation Vcore Low Side




Top  Dual Cool™ 56  Bottom




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

| Symbol | Parameter | | | Ratings | Units |
|---|---|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | | | 60 | V |
| $V_{GS}$ | Gate to Source Voltage | | | ±20 | V |
| $I_D$ | Drain Current -Continuous | $T_C$ = 25 °C | | 108 | A |
| | -Continuous | $T_A$ = 25 °C | (Note 1a) | 29 | |
| | -Pulsed | | | 200 | |
| $E_{AS}$ | Single Pulse Avalanche Energy | | (Note 3) | 317 | mJ |
| $P_D$ | Power Dissipation | $T_C$ = 25 °C | | 125 | W |
| | 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) | 2.8 | °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 |
|---|---|---|---|---|---|
| 86500 | FDMS86500DC | Dual Cool™ 56 | 13" | 12 mm | 3000 units |

## Electrical Characteristics $T_J$ = 25 °C unless otherwise noted

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

### Off Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = 250 μA, $V_{GS}$ = 0 V | 60 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, referenced to 25°C | | 30 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 48 V, $V_{GS}$ = 0 V | | | 1 | μA |
| $I_{GSS}$ | Gate to Source Leakage Current | $V_{GS}$ = ±20 V, $V_{DS}$ = 0 V | | | ±100 | nA |

### On Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | 2.5 | 3.7 | 4.5 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D$ = 250 μA, referenced to 25 °C | | -12 | | mV/°C |
| $r_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 10 V, $I_D$ = 29 A | | 1.9 | 2.3 | mΩ |
| | | $V_{GS}$ = 8 V, $I_D$ = 24 A | | 2.4 | 3.3 | |
| | | $V_{GS}$ = 10 V, $I_D$ = 29 A, $T_J$ = 125 °C | | 3.0 | 3.7 | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 10 V, $I_D$ = 29 A | | 98 | | S |

### Dynamic Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 30 V, $V_{GS}$ = 0 V, f = 1 MHz | | 5775 | 7680 | pF |
| $C_{oss}$ | Output Capacitance | | | 1605 | 2680 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 48 | 95 | pF |
| $R_g$ | Gate Resistance | | 0.1 | 1 | 3 | Ω |

### Switching Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 30 V , $I_D$ = 29 A, $V_{GS}$ = 10 V, $R_{GEN}$ = 6 Ω | | 35 | 56 | ns |
| $t_r$ | Rise Time | | | 25 | 40 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 34 | 54 | ns |
| $t_f$ | Fall Time | | | 8.2 | 17 | ns |
| $Q_{g(TOT)}$ | Total Gate Charge | $V_{GS}$ = 0 V to 10 V; $V_{DD}$ = 30 V, $I_D$ = 29 A | | 76 | 107 | nC |
| | Total Gate Charge | $V_{GS}$ = 0 V to 8 V; $V_{DD}$ = 30 V, $I_D$ = 29 A | | 62 | 87 | nC |
| $Q_{gs}$ | Total Gate Charge | $V_{DD}$ = 30 V, $I_D$ = 29 A | | 31 | | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | | 15 | | nC |

### Drain-Source Diode Characteristics

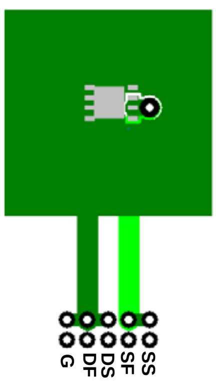
| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 2.7 A (Note 2) | | 0.71 | 1.2 | V |
| | | $V_{GS}$ = 0 V, $I_S$ = 29 A (Note 2) | | 0.79 | 1.3 | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 29 A, di/dt = 100 A/μs | | 59 | 95 | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 46 | 74 | nC |

## Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | (Top Source) | 2.8 | °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 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:

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


b. 81 °C/W when mounted on a minimum pad of 2 oz copper

c. Still air, 20.9x10.4x12.7mm Aluminum Heat Sink, 1 in$^2$ pad of 2 oz copper

d. Still air, 20.9x10.4x12.7mm Aluminum Heat Sink, minimum pad of 2 oz copper

e. Still air, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, 1 in$^2$ pad of 2 oz copper

f. Still air, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, minimum pad of 2 oz copper

g. 200FPM Airflow, No Heat Sink,1 in$^2$ pad of 2 oz copper

h. 200FPM Airflow, No Heat Sink, minimum pad of 2 oz copper

i. 200FPM Airflow, 20.9x10.4x12.7mm Aluminum Heat Sink, 1 in$^2$ pad of 2 oz copper

j. 200FPM Airflow, 20.9x10.4x12.7mm Aluminum Heat Sink, minimum pad of 2 oz copper

k. 200FPM Airflow, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, 1 in$^2$ pad of 2 oz copper

l. 200FPM Airflow, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, minimum pad of 2 oz copper

2. Pulse Test: Pulse Width < 300 μs, Duty cycle < 2.0%.

3. Starting $T_J$ = 25 $^oC$; N-ch: L = 0.3 mH, $I_{AS}$ = 46 A, $V_{DD}$ = 54 V, $V_{GS}$ = 10 V.

## Typical Characteristics $T_J$ = 25 °C unless otherwise noted

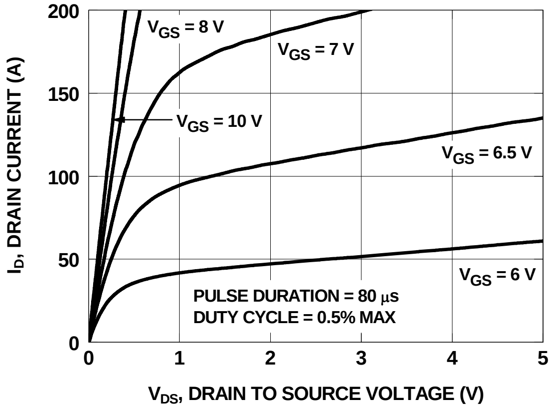



**Figure 1. On-Region Characteristics**

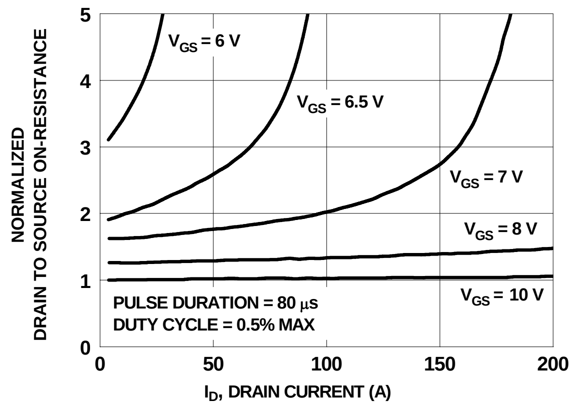



**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**

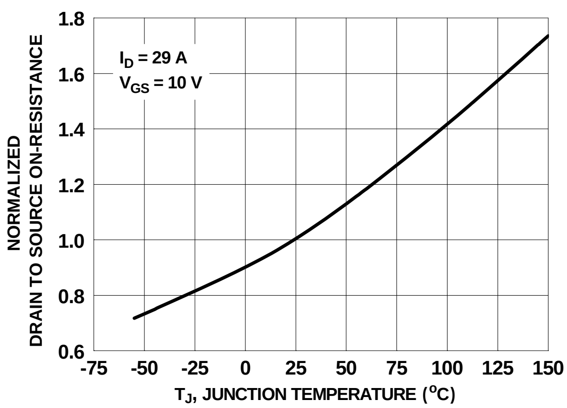



**Figure 3. Normalized On-Resistance vs Junction Temperature**

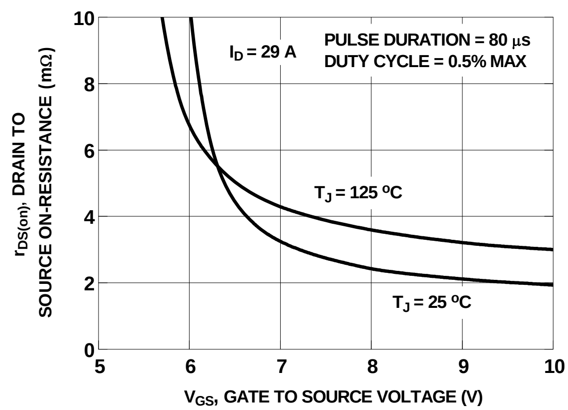



**Figure 4. On-Resistance vs Gate to Source Voltage**

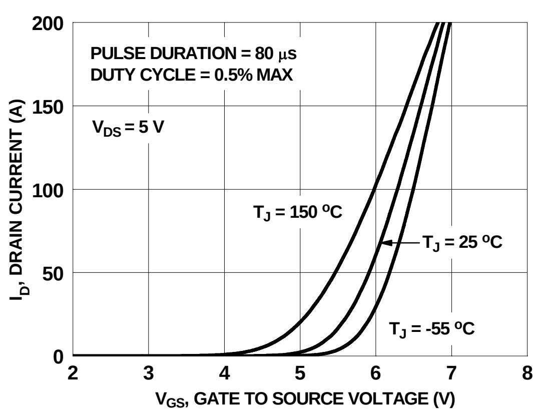



**Figure 5. Transfer Characteristics**

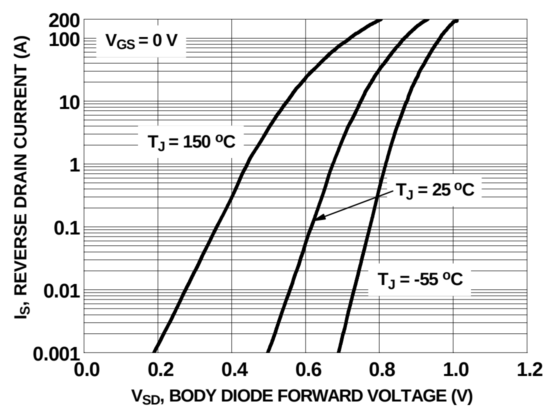



**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

## Typical Characteristics $T_J$ = 25 °C unless otherwise noted

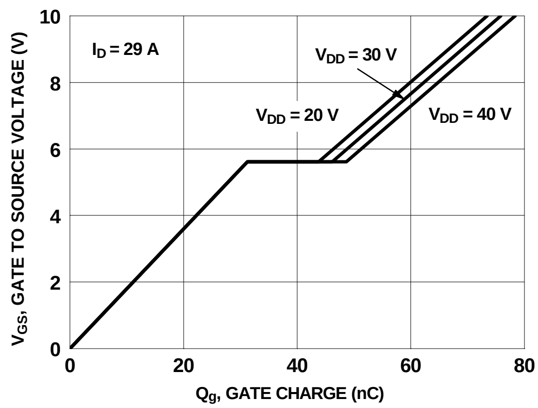



**Figure 7. Gate Charge Characteristics**

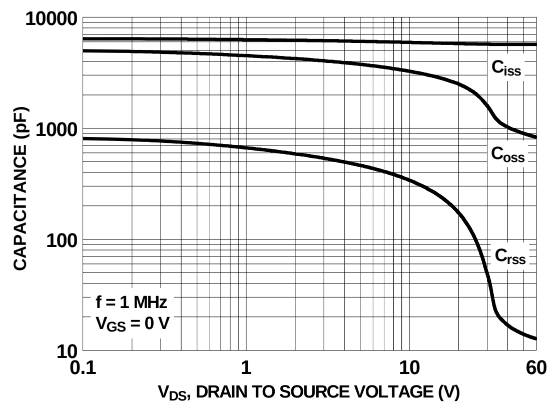



**Figure 8. Capacitance vs Drain to Source Voltage**

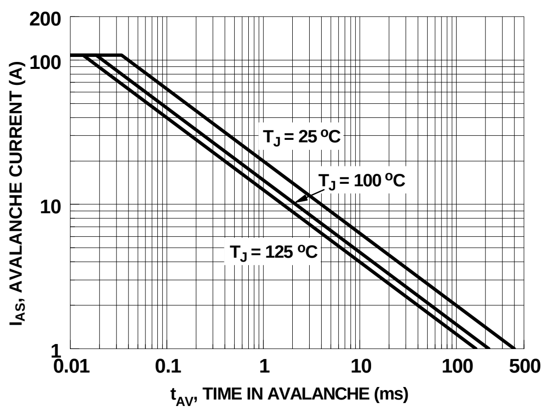



**Figure 9. Unclamped Inductive Switching Capability**

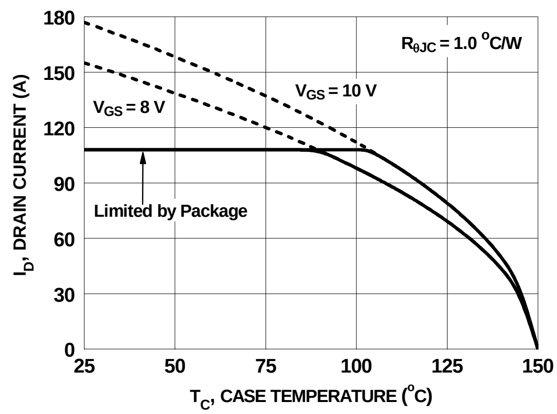



**Figure 10. Maximum Continuous Drain Current vs Case Temperature**

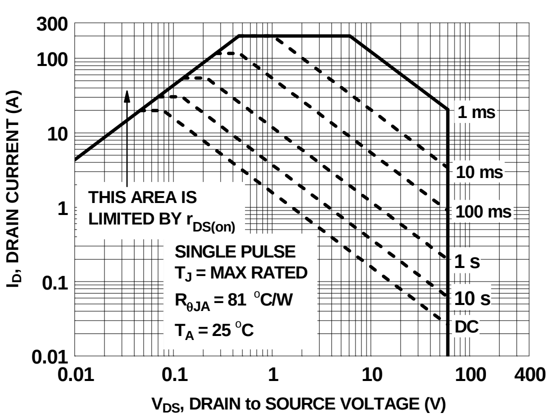



**Figure 11. Forward Bias Safe Operating Area**

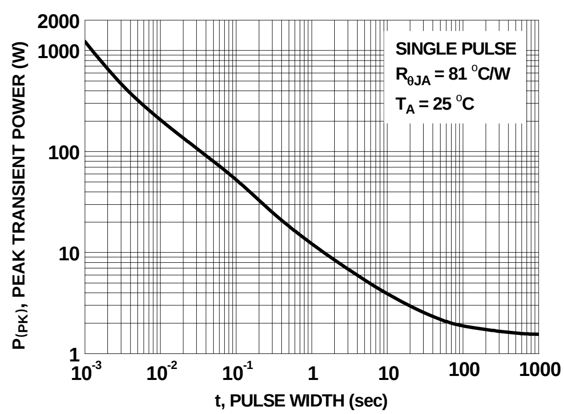



**Figure 12. Single Pulse Maximum Power Dissipation**

## Typical Characteristics $T_J$ = 25 °C unless otherwise noted

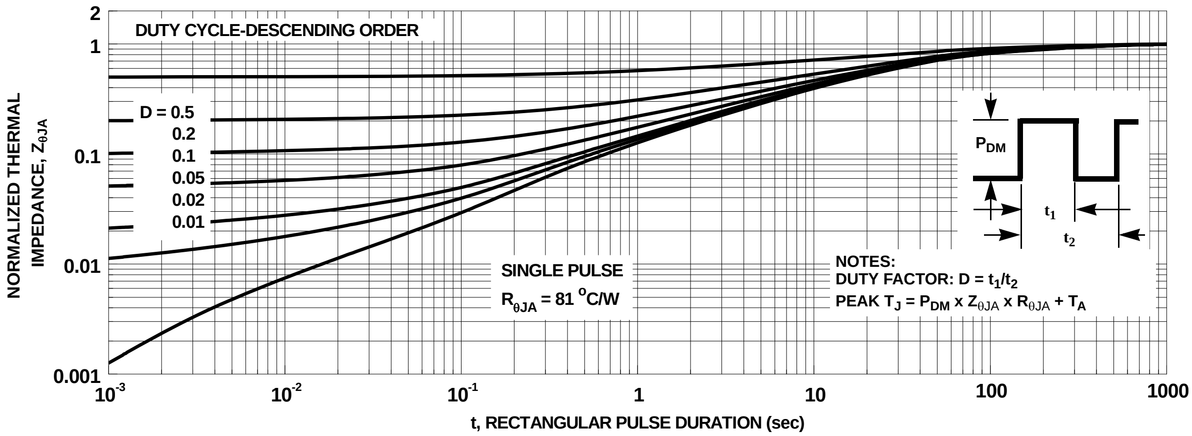
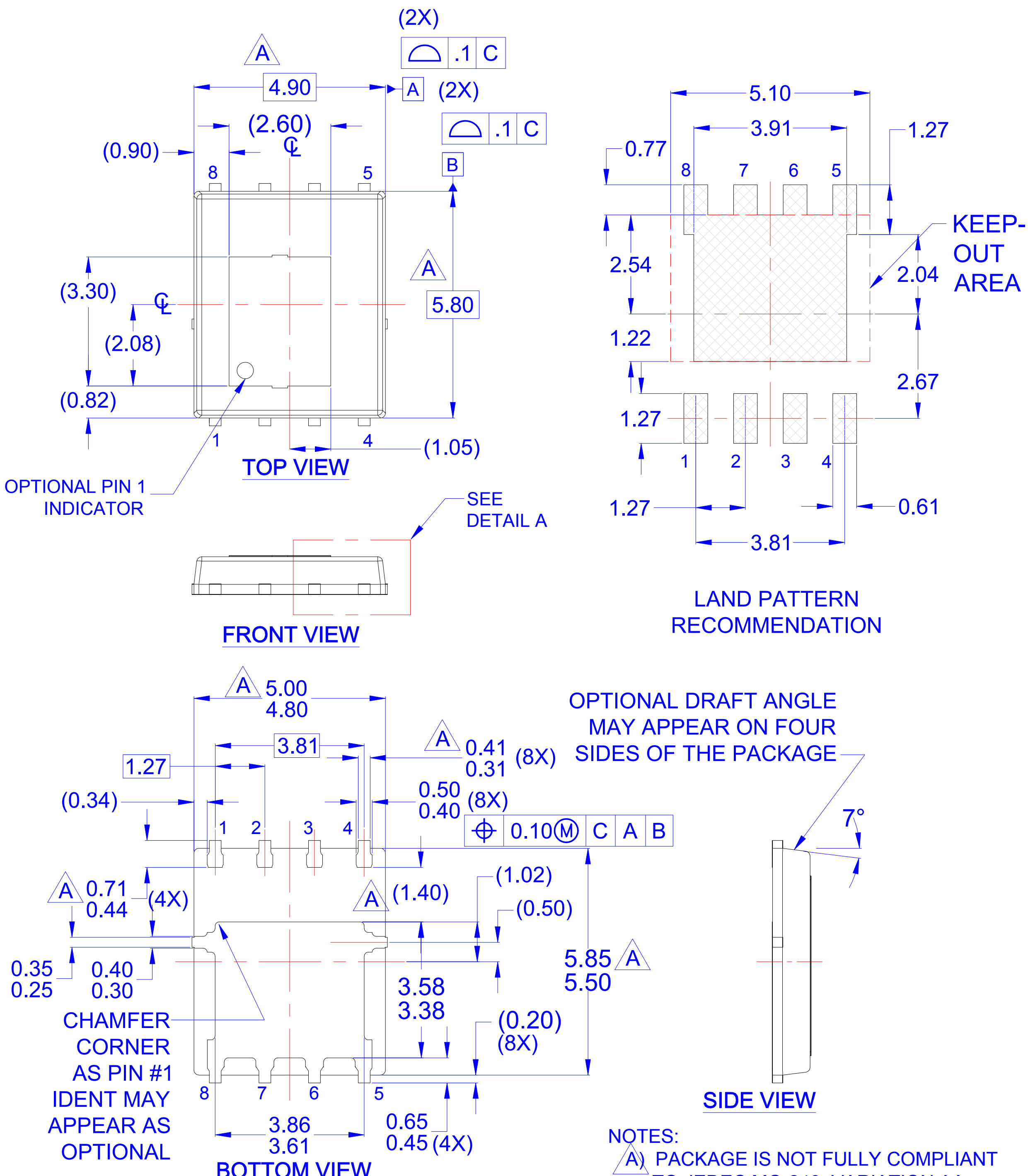
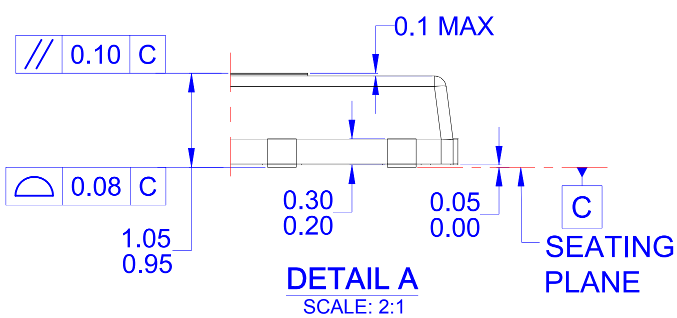



**Figure 13. Junction-to-Ambient Transient Thermal Response Curve**




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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**Электронная почта:** org@eplast1.ru
**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.