FAIRCHILD SEMICONDUCTOR®

March 2012

# FDMS7650DC

## N-Channel Dual Cool™ PowerTrench® MOSFET

**30 V, 100 A, 0.99 mΩ**

### Features

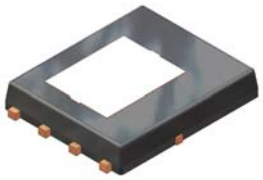
- Dual Cool™ Top Side Cooling PQFN package
- Max $r_{DS(on)}$ = 0.99 mΩ at $V_{GS}$ = 10 V, $I_D$ = 36 A
- Max $r_{DS(on)}$ = 1.55 mΩ at $V_{GS}$ = 4.5 V, $I_D$ = 32 A
- High performance technology for extremely low $r_{DS(on)}$
- RoHS Compliant

### General Description

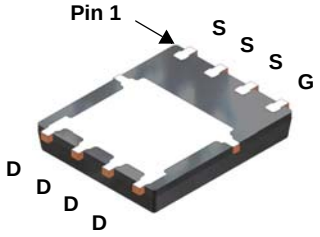
This N-Channel MOSFET is produced using Fairchild Semiconductor's advanced PowerTrench® process. Advancements in both silicon and Dual Cool™ package technologies have been combined to offer the lowest $r_{DS(on)}$ while maintaining excellent switching performance by extremely low Junction-to-Ambient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

### Applications

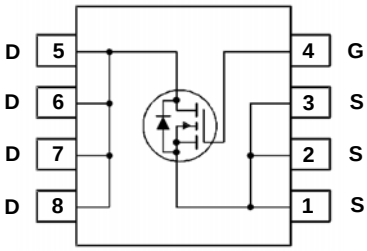
- Synchronous Rectifier for DC/DC Converters
- Telecom Secondary Side Rectification
- High End Server/Workstation



Top




Power 56 Bottom




## 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 | | (Note 4) | ±20 | V |
| $I_D$ | Drain Current -Continuous (Package limited) | $T_C$ = 25 °C | | 100 | A |
| | -Continuous (Silicon limited) | $T_C$ = 25 °C | | 289 | |
| | -Continuous | $T_A$ = 25 °C | (Note 1a) | 47 | |
| | -Pulsed | | | 200 | |
| $E_{AS}$ | Single Pulse Avalanche Energy | | (Note 3) | 578 | mJ |
| dv/dt | Peak Diode Recovery dv/dt | | (Note 5) | 0.5 | V/ns |
| $P_D$ | Power Dissipation | $T_C$ = 25 °C | | 125 | W |
| | Power Dissipation | $T_A$ = 25 °C | (Note 1a) | 3.3 | |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | | | -55 to +150 | °C |

### Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | (Top Source) | 2.3 | °C/W |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | (Bottom Drain) | 1 | |
| $R_{\theta JA}$ | 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 |
|---|---|---|---|---|---|
| 7650 | FDMS7650DC | Dual Cool™ Power 56 | 13 " | 12 mm | 3000 units |

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

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = 250 μA, $V_{GS}$ = 0 V | 30 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, referenced to 25 °C | | 12 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 24 V, $V_{GS}$ = 0 V | | | 1 | μA |
| $I_{GSS}$ | Gate to Source Leakage Current, Forward | $V_{GS}$ = 20 V, $V_{DS}$ = 0 V | | | 100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | 1.1 | 1.9 | 2.7 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D$ = 250 μA, referenced to 25 °C | | -7 | | mV/°C |
| $r_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 10 V, $I_D$ = 36 A | | 0.6 | 0.99 | mΩ |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 32 A | | 1 | 1.55 | |
| | | $V_{GS}$ = 10 V, $I_D$ = 36 A, $T_J$ = 125 °C | | 0.9 | 1.5 | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 5 V, $I_D$ = 36 A | | 225 | | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 15 V, $V_{GS}$ = 0 V, f = 1 MHz | | 11100 | 14765 | pF |
| $C_{oss}$ | Output Capacitance | | | 3440 | 4575 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 205 | 310 | pF |
| $R_g$ | Gate Resistance | | | 1.3 | | Ω |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 15 V, $I_D$ = 36 A, $V_{GS}$ = 10 V, $R_{GEN}$ = 6 Ω | | 29 | 46 | ns |
| $t_r$ | Rise Time | | | 28 | 45 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 81 | 130 | ns |
| $t_f$ | Fall Time | | | 20 | 32 | ns |
| $Q_g$ | Total Gate Charge | $V_{GS}$ = 0 V to 10 V; $V_{DD}$ = 15 V, $I_D$ = 36 A | | 147 | 206 | nC |
| $Q_g$ | Total Gate Charge | $V_{GS}$ = 0 V to 4.5 V; $V_{DD}$ = 15 V, $I_D$ = 36 A | | 62 | 87 | nC |
| $Q_{gs}$ | Gate to Source Charge | $V_{DD}$ = 15 V, $I_D$ = 36 A | | 38 | | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | | 9.7 | | nC |
| **Drain-Source Diode Characteristics** | | | | | | |
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 2.1 A (Note 2) | | 0.7 | 1.2 | V |
| | | $V_{GS}$ = 0 V, $I_S$ = 36 A (Note 2) | | 0.8 | 1.3 | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 36 A, di/dt = 100 A/μs | | 75 | 120 | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 61 | 98 | nC |

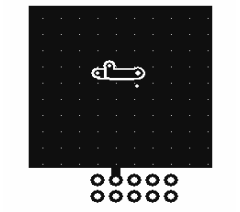
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## Thermal Characteristics

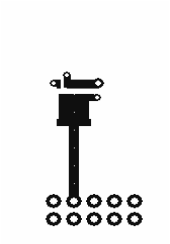
| | | | | |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | (Top Source) | 2.3 | °C/W |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | (Bottom Drain) | 1 | |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1a) | 38 | |
| $R_{\theta JA}$ | 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. $E_{AS}$ of 578 mJ is based on starting $T_J$ = 25 °C; N-ch: L = 1 mH, $I_{AS}$ = 34 A, $V_{DD}$ = 27 V, $V_{GS}$ = 10 V.

4. As an N-ch device, the negative Vgs rating is for low duty cycle pulse ocurrence only. No continuous rating is implied.

5. $I_{SD} \leq 36$ A, di/dt ≤ 100 A/μs, $V_{DD} \leq BV_{DSS}$, Starting $T_J$ = 25 °C.

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

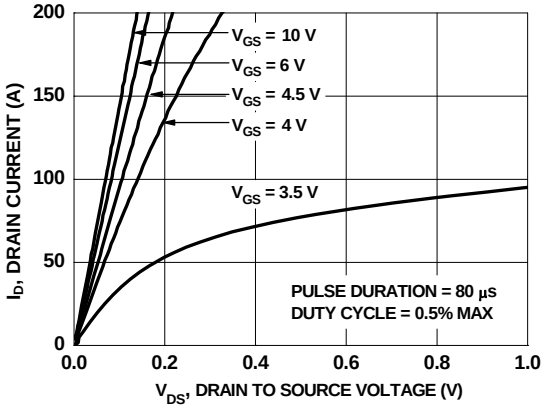



**Figure 1. On Region Characteristics**

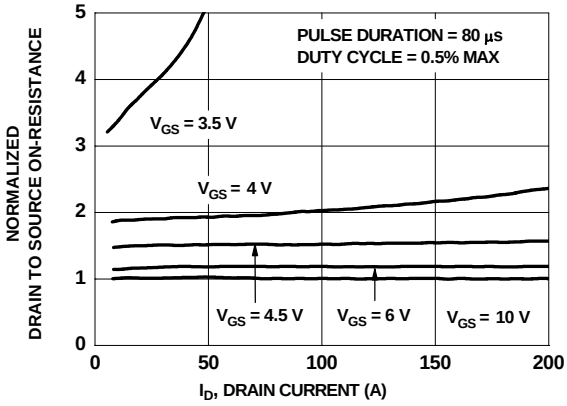



**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**

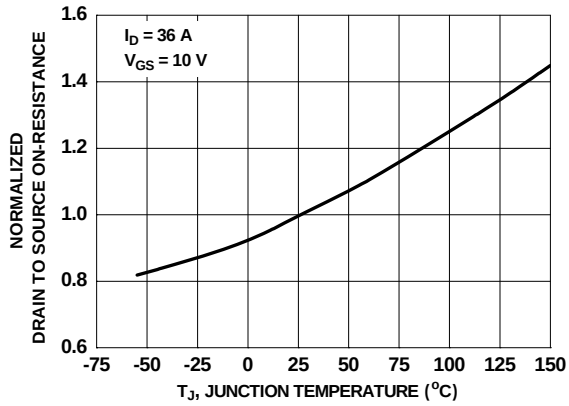



**Figure 3. Normalized On Resistance vs Junction Temperature**

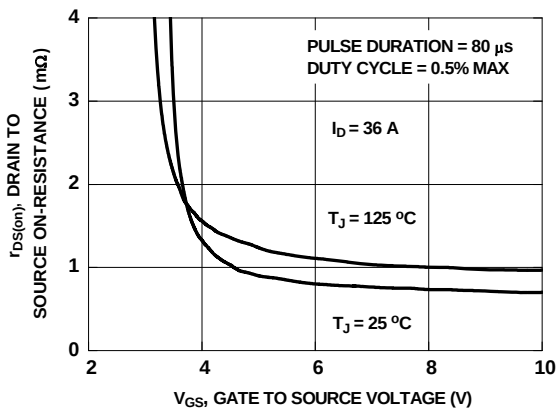



**Figure 4. On-Resistance vs Gate to Source Voltage**

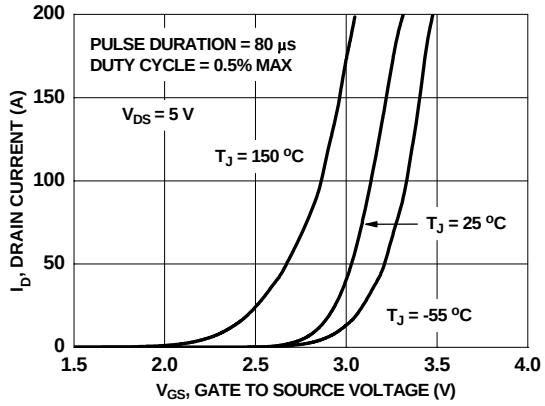



**Figure 5. Transfer Characteristics**

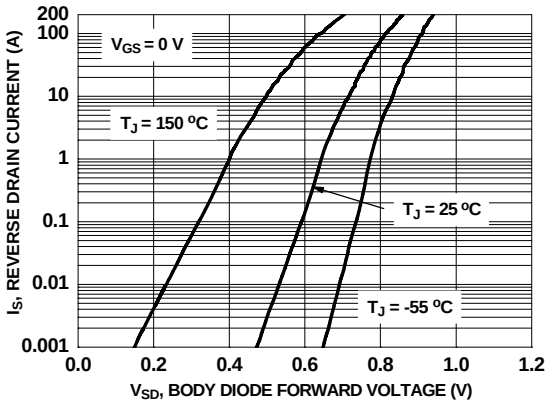



**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

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

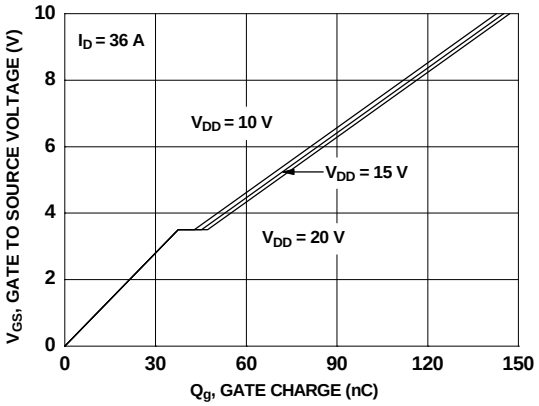



**Figure 7. Gate Charge Characteristics**

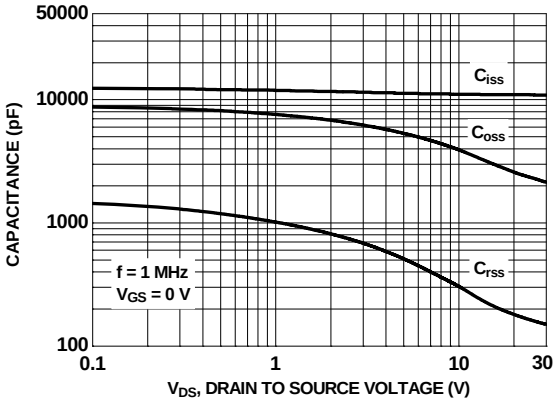



**Figure 8. Capacitance vs Drain to Source Voltage**

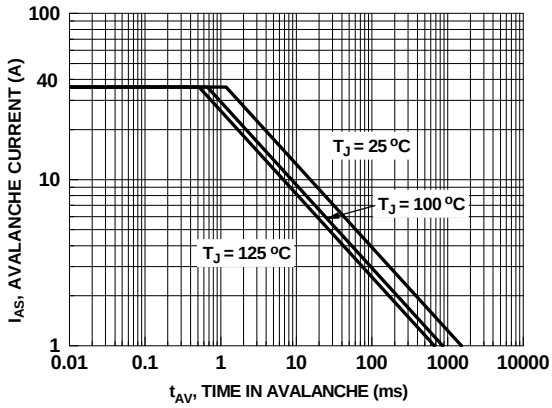



**Figure 9. Unclamped Inductive Switching Capability**

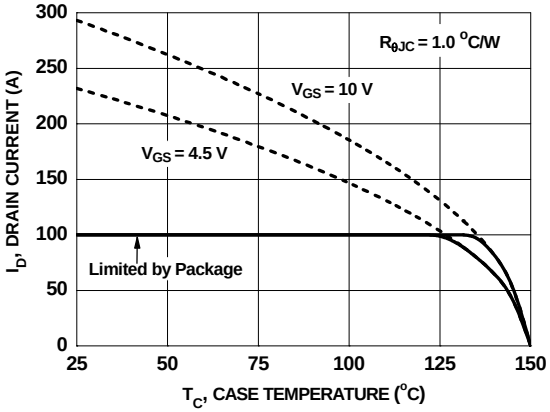



**Figure 10. Maximum Continuous Drain Current vs Case Temperature**

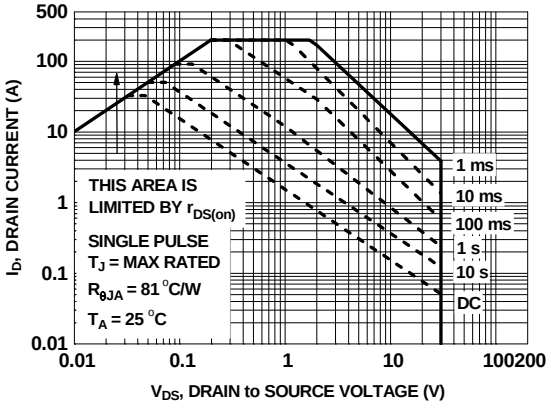



**Figure 11. Forward Bias Safe Operating Area**

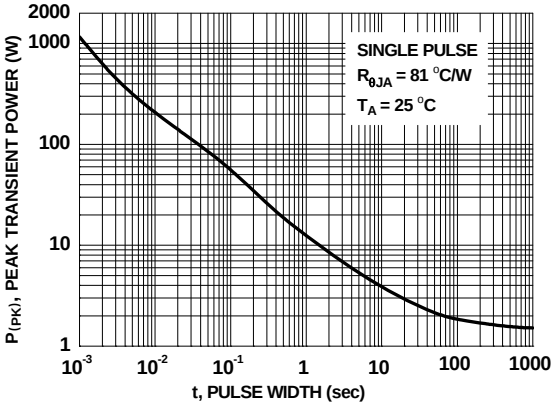



**Figure 12. Single Pulse Maximum Power Dissipation**

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

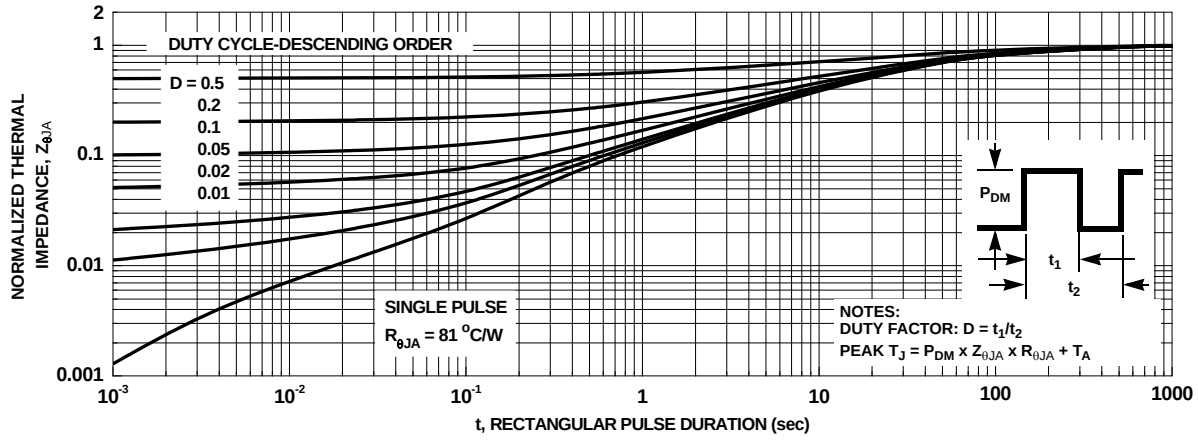
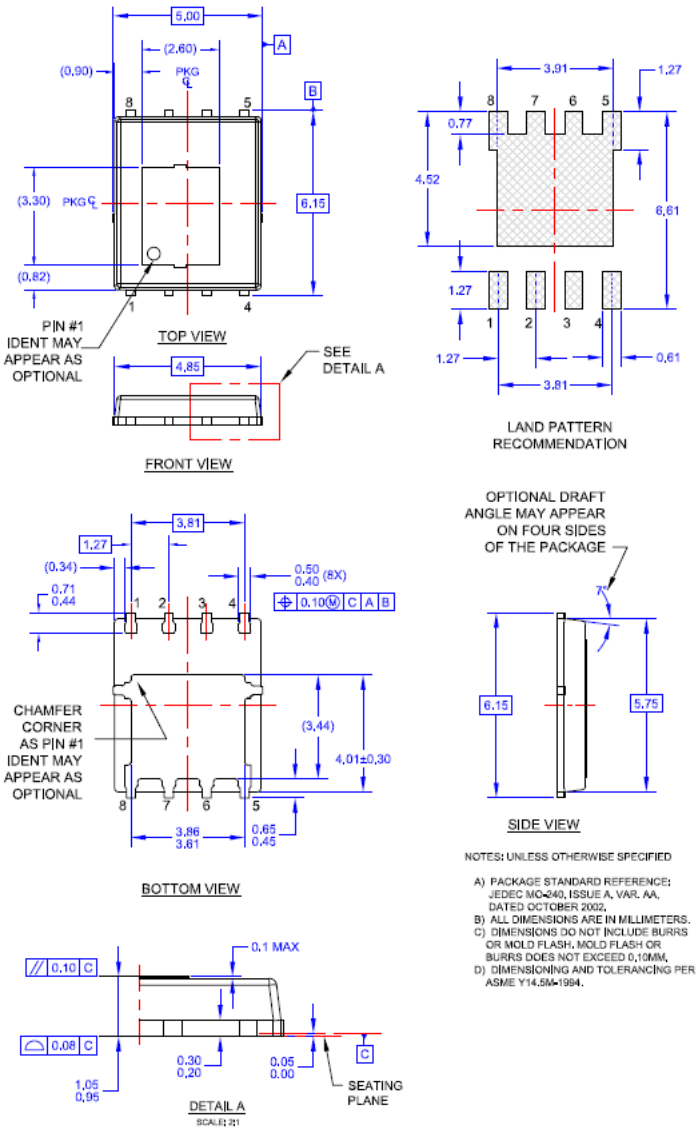



**Figure 13. Junction-to-Ambient Transient Thermal Response Curve**

## Dimensional Outline and Pad Layout



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