

FDMS2506SDC

N-Channel Dual Cool™ PowerTrench® SyncFET™ 25 V, 49 A, 1.45 mΩ

Features

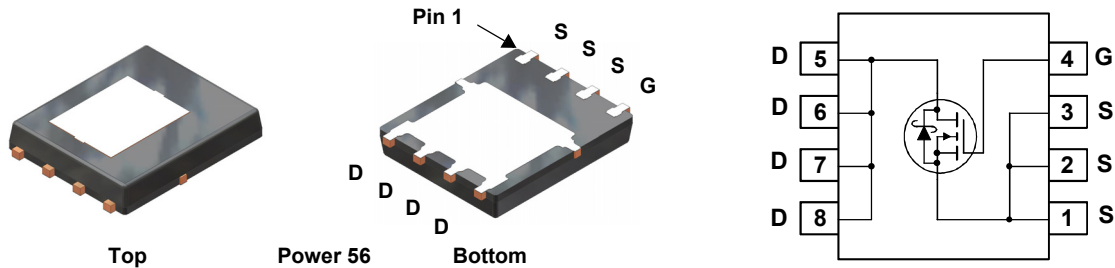
- Dual Cool™ Top Side Cooling PQFN package
- Max $r_{DS(on)}$ = 1.45 mΩ at $V_{GS} = 10\text{ V}$, $I_D = 30\text{ A}$
- Max $r_{DS(on)}$ = 2.1 mΩ at $V_{GS} = 4.5\text{ V}$, $I_D = 26\text{ A}$
- High performance technology for extremely low $r_{DS(on)}$
- SyncFET Schottky Body Diode
- RoHS Compliant

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. This device has the added benefit of an efficient monolithic Schottky body diode.

Applications

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



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

| Symbol | Parameter | Rated | Units |
|----------------|--|-------------|------------------|
| V_{DS} | Drain to Source Voltage | 25 | V |
| V_{GS} | Gate to Source Voltage (Note 4) | ±20 | V |
| I_D | Drain Current -Continuous (Package limited) $T_C = 25^\circ\text{C}$ | 49 | A |
| | -Continuous (Silicon limited) $T_C = 25^\circ\text{C}$ | 202 | |
| | -Continuous $T_A = 25^\circ\text{C}$ (Note 1a) | 39 | |
| | -Pulsed | 200 | |
| E_{AS} | Single Pulse Avalanche Energy (Note 3) | 220 | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 5) | 1.6 | V/ns |
| P_D | Power Dissipation $T_C = 25^\circ\text{C}$ | 89 | W |
| | Power Dissipation $T_A = 25^\circ\text{C}$ (Note 1a) | 3.3 | |
| 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 (Top Source) | 2.7 | $^\circ\text{C/W}$ |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case (Bottom Drain) | 1.4 | |
| $R_{\theta JA}$ | 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 |
|----------------|-------------|---------------------|-----------|------------|------------|
| 2506S | FDMS2506SDC | Dual Cool™ Power 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 | $I_D = 1\text{ mA}, V_{GS} = 0\text{ V}$ | 25 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 10\text{ mA}$, referenced to $25\text{ }^\circ\text{C}$ | | 21 | | mV/ $^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$ | | | 500 | μA |
| 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 | $V_{GS} = V_{DS}, I_D = 1\text{ mA}$ | 1.2 | 1.7 | 3.0 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D = 10\text{ mA}$, referenced to $25\text{ }^\circ\text{C}$ | | -5 | | mV/ $^\circ\text{C}$ |
| $r_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{ V}, I_D = 30\text{ A}$ | | 1.2 | 1.45 | m Ω |
| | | $V_{GS} = 4.5\text{ V}, I_D = 26\text{ A}$ | | 1.6 | 2.1 | |
| | | $V_{GS} = 10\text{ V}, I_D = 30\text{ A}, T_J = 125\text{ }^\circ\text{C}$ | | 1.6 | 2.0 | |
| g_{FS} | Forward Transconductance | $V_{DS} = 5\text{ V}, I_D = 30\text{ A}$ | | 171 | | S |

Dynamic Characteristics

| | | | | | | |
|------------|------------------------------|--|--|------|------|----------|
| C_{iss} | Input Capacitance | $V_{DS} = 13\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$ | | 4470 | 5945 | pF |
| C_{oss} | Output Capacitance | | | 1200 | 1560 | pF |
| C_{riss} | Reverse Transfer Capacitance | | | 244 | 370 | pF |
| R_g | Gate Resistance | | | 0.8 | 1.8 | Ω |

Switching Characteristics

| | | | | | | | |
|--------------|-------------------------------|---|---------------------------------------|------|----|----|----|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 13\text{ V}, I_D = 30\text{ A},$ $V_{GS} = 10\text{ V}, R_{GEN} = 6\text{ }\Omega$ | | 16 | 29 | ns | |
| t_r | Rise Time | | | 7.4 | 15 | ns | |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 41 | 66 | ns | |
| t_f | Fall Time | | | 4.8 | 10 | ns | |
| Q_g | Total Gate Charge | | $V_{GS} = 0\text{ V to }10\text{ V}$ | | 66 | 93 | nC |
| Q_g | Total Gate Charge | | $V_{GS} = 0\text{ V to }4.5\text{ V}$ | | 30 | 43 | nC |
| Q_{gs} | Gate to Source Gate Charge | $V_{DD} = 13\text{ V},$ $I_D = 30\text{ A}$ | | 13.4 | | nC | |
| Q_{gd} | Gate to Drain "Miller" Charge | | | 7.5 | | nC | |

Drain-Source Diode Characteristics

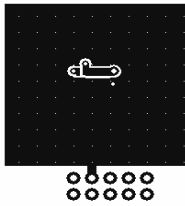
| | | | | | | |
|----------|---------------------------------------|---|--|------|-----|----|
| V_{SD} | Source to Drain Diode Forward Voltage | $V_{GS} = 0\text{ V}, I_S = 2\text{ A}$ (Note 2) | | 0.40 | 0.7 | V |
| | | $V_{GS} = 0\text{ V}, I_S = 30\text{ A}$ (Note 2) | | 0.76 | 1.2 | |
| t_{rr} | Reverse Recovery Time | $I_F = 30\text{ A}, di/dt = 300\text{ A}/\mu\text{s}$ | | 35 | 56 | ns |
| Q_{rr} | Reverse Recovery Charge | | | 39 | 63 | nC |

Thermal Characteristics

| | | | |
|-----------------|---|-----|-----------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case (Top Source) | 2.7 | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case (Bottom Drain) | 1.4 | |
| $R_{\theta JA}$ | 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 in² 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 in² 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 in² 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 in² 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 in² 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 in² 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 μs , Duty cycle < 2.0%.
 - E_{AS} of 220 mJ is based on starting $T_J = 25^{\circ}\text{C}$, $L = 1$ mH, $I_{AS} = 21$ A, $V_{DD} = 23$ V, $V_{GS} = 10$ V. 100% test at $L = 0.3$ mH, $I_{AS} = 32$ A.
 - As an N-ch device, the negative V_{GS} rating is for low duty cycle pulse occurrence only. No continuous rating is implied.
 - $I_{SD} \leq 30$ A, $di/dt \leq 200$ A/ μs , $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^{\circ}\text{C}$.

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

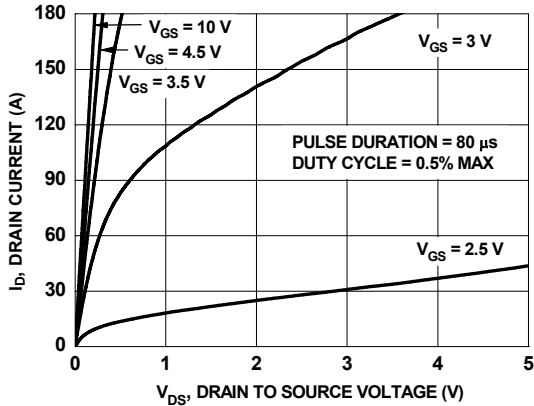


Figure 1. On-Region Characteristics

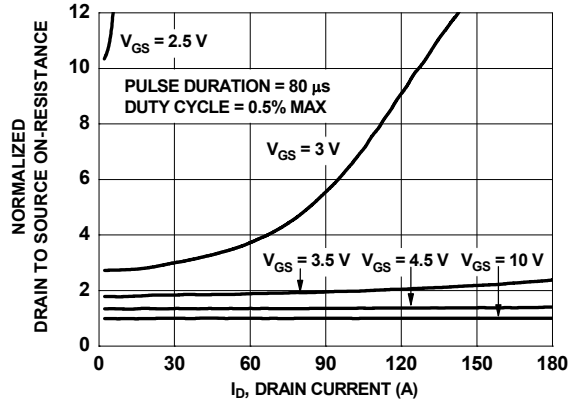


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

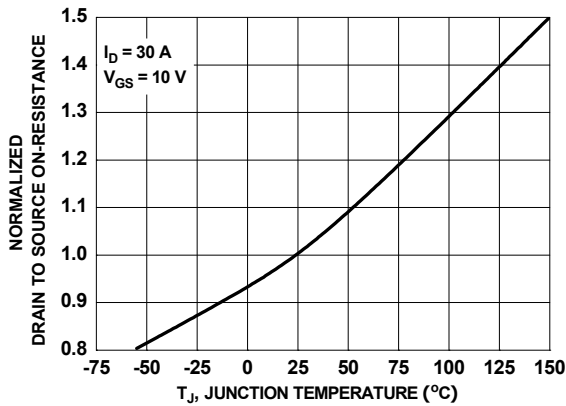


Figure 3. Normalized On-Resistance vs Junction Temperature

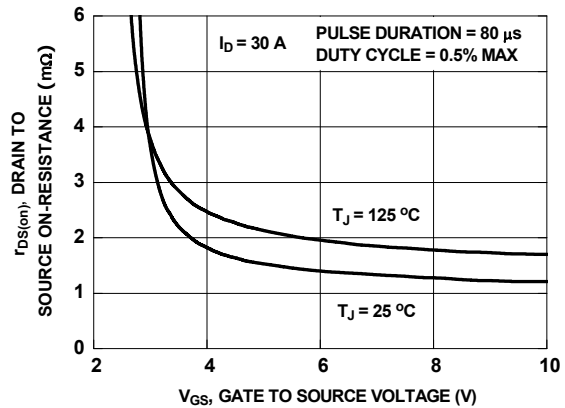


Figure 4. On-Resistance vs Gate to Source Voltage

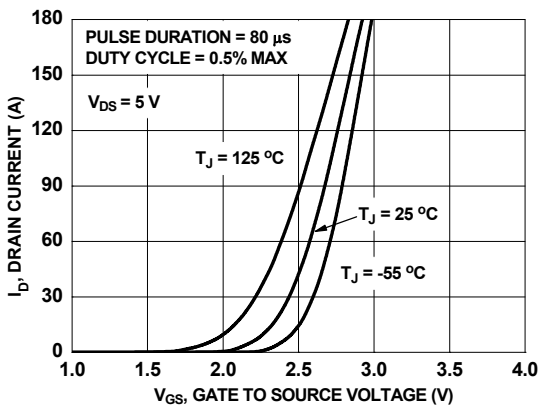


Figure 5. Transfer Characteristics

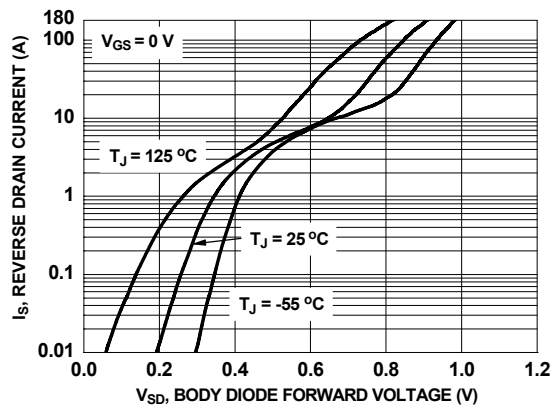


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

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

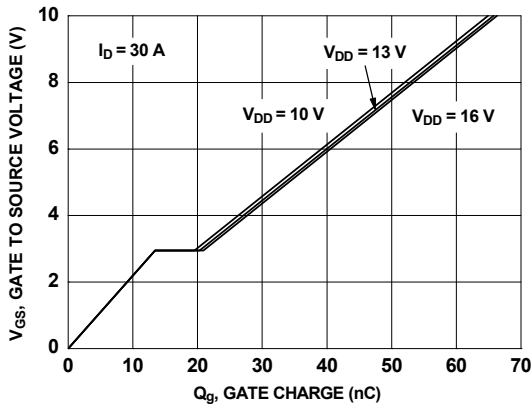


Figure 7. Gate Charge Characteristics

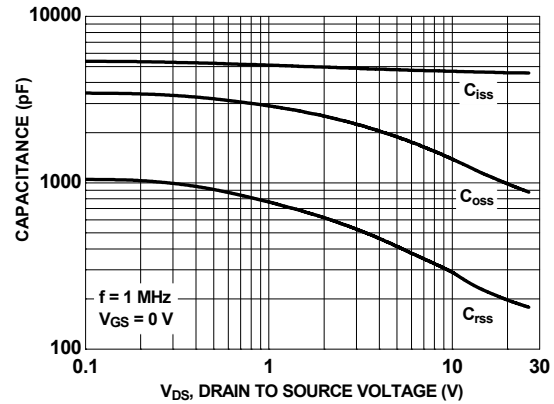


Figure 8. Capacitance vs Drain to Source Voltage

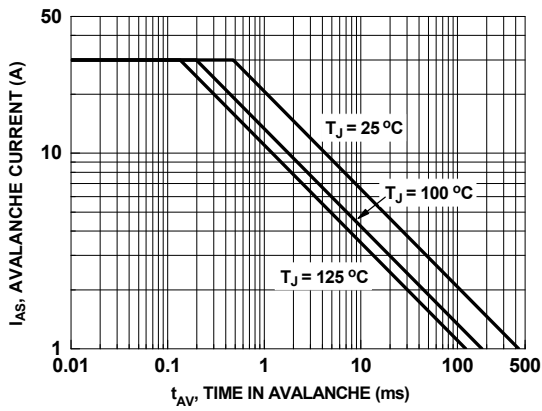


Figure 9. Unclamped Inductive Switching Capability

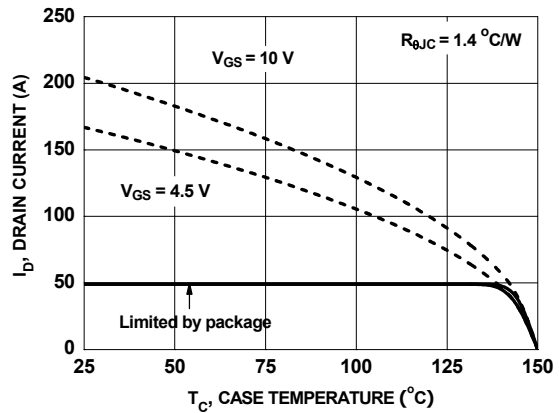


Figure 10. Maximum Continuous Drain Current vs Case Temperature

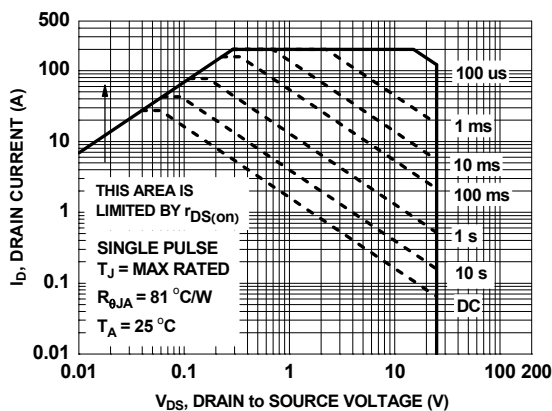


Figure 11. Forward Bias Safe Operating Area

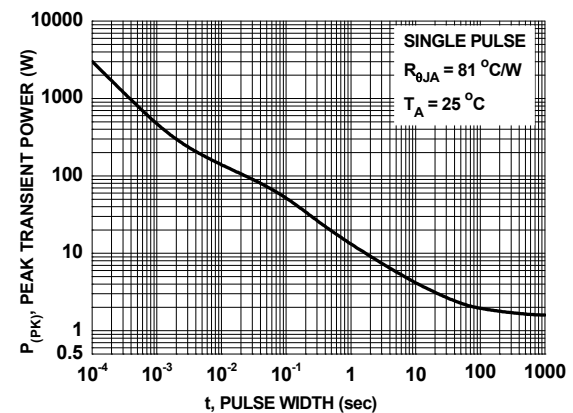


Figure 12. Single Pulse Maximum Power Dissipation

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

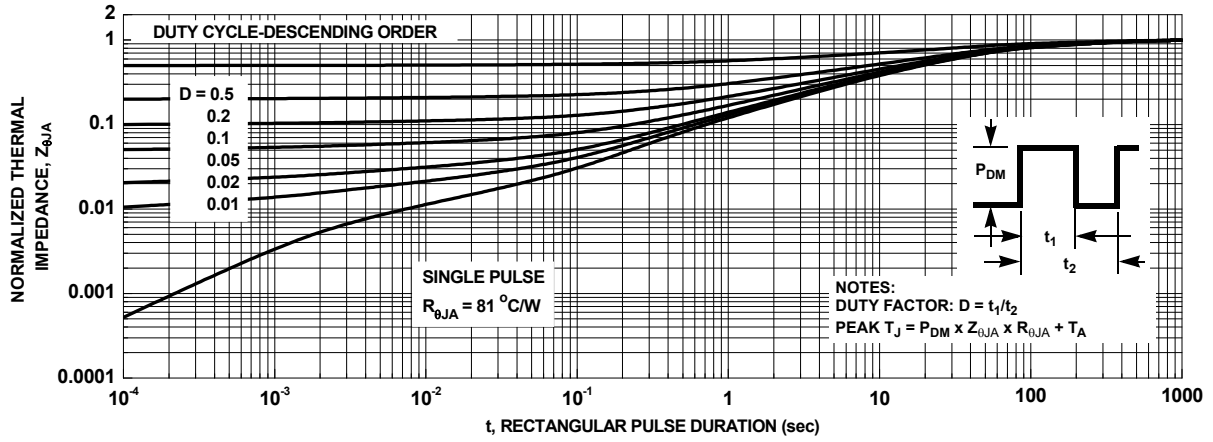


Figure 13. Junction-to-Ambient Transient Thermal Response Curve

Typical Characteristics (continued)

SyncFET Schottky body diode Characteristics

Fairchild's SyncFET process embeds a Schottky diode in parallel with PowerTrench MOSFET. This diode exhibits similar characteristics to a discrete external Schottky diode in parallel with a MOSFET. Figure 14 shows the reverse recovery characteristic of the FDMS2506SDC.

Schottky barrier diodes exhibit significant leakage at high temperature and high reverse voltage. This will increase the power in the device.

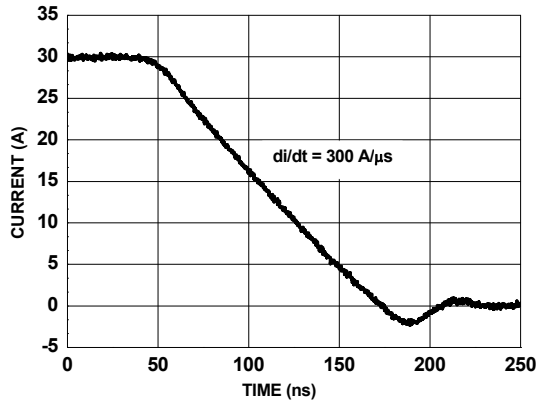


Figure 14. FDMS2506SDC SyncFET body diode reverse recovery characteristic

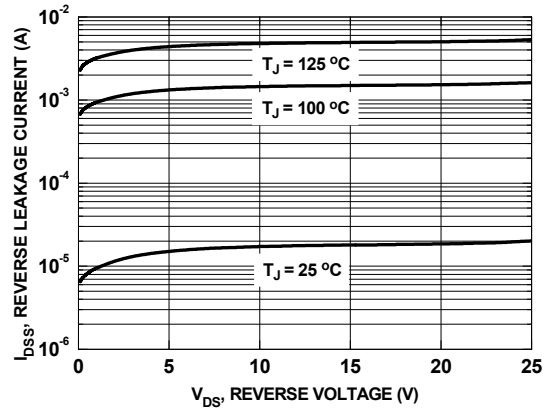
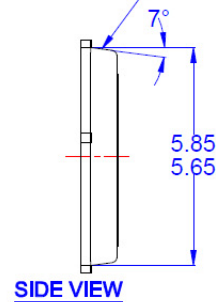
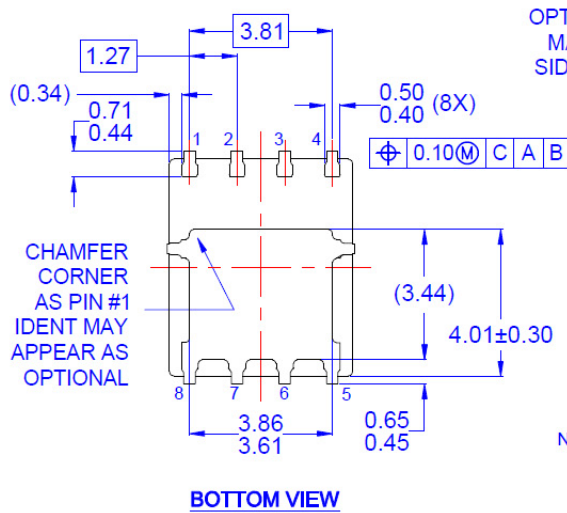
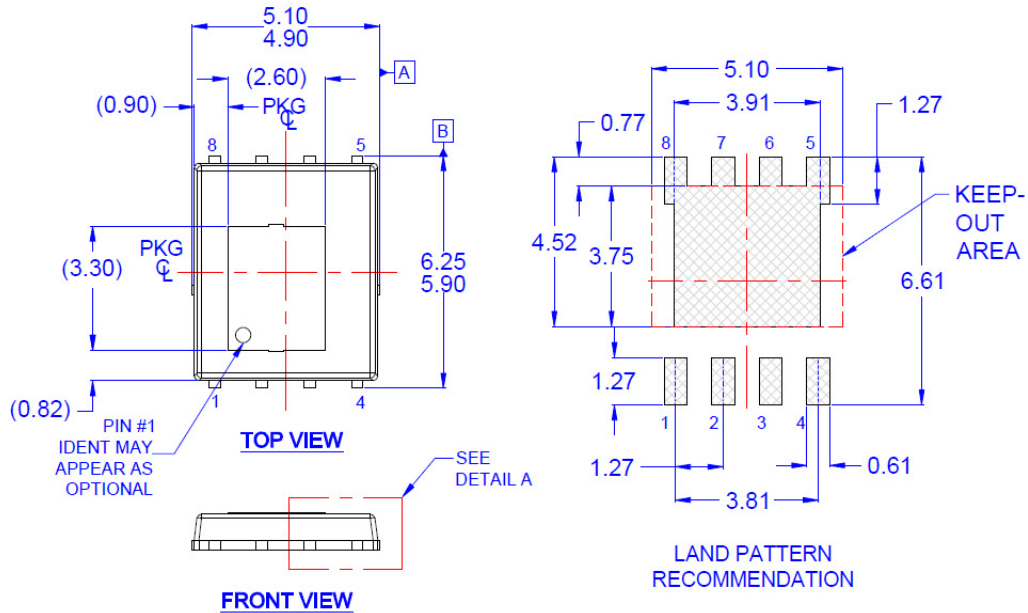
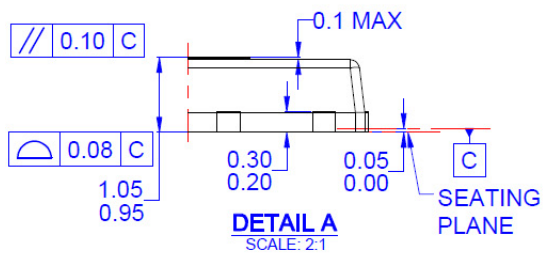


Figure 15. SyncFET body diode reverse leakage versus drain-source voltage

Dimensional Outline and Pad Layout



- NOTES: UNLESS OTHERWISE SPECIFIED
- A) PACKAGE STANDARD REFERENCE: JEDEC MO-240, ISSUE A, VAR. AA, DATED OCTOBER 2002.
 - 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-1994.
 - E) IT IS RECOMMENDED TO HAVE NO TRACES OR VIAS WITHIN THE KEEP OUT AREA.





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