# SyncFET™ – N-Channel, POWERTRENCH®

## 30 V, 42 A, 4.9 mΩ

# FDMS0312S

| $V_{DS}$ MAX | $r_{DS(on)}$ MAX | $I_D$ MAX |
|---|---|---|
| 30 V | 4.9 mΩ @ 10 V | 42 A |
| | 5.8 mΩ @ 4.5 V | |

### General Description

The FDMS0312S has been designed to minimize losses in power conversion application. Advancements in both silicon and package technologies have been combined to offer the lowest $r_{DS(on)}$ while maintaining excellent switching performance. This device has the added benefit of an efficient monolithic Schottky body diode.

### Features

- Max $r_{DS(on)}$ = 4.9 mΩ at $V_{GS}$ = 10 V, $I_D$ = 18 A
- Max $r_{DS(on)}$ = 5.8 mΩ at $V_{GS}$ = 4.5 V, $I_D$ = 14 A
- Advanced Package and Silicon Combination for Low $r_{DS(on)}$ and High Efficiency
- SyncFET Schottky Body Diode
- MSL1 Robust Package Design
- 100% UIL Tested
- This Device is Pb–Free, Halide Free and is RoHS Compliant

### Applications

- Synchronous Rectifier for DC/DC Converters
- Notebook Vcore/GPU Low Side Switch
- Networking Point of Load Low Side Switch
- Telecom Secondary Side Rectification

**PQFN8 5X6, 1.27P
(Power 56)
CASE 483AE**

### MARKING DIAGRAM

&Z&3&K
FDMS
0312S

| | |
|---|---|
| &Z | = Assembly Plant Code |
| &3 | = 3–Digit Date Code |
| &K | = 2–Digits Lot Run Code |
| FDMS0312S | = Specific Device Code |

### PIN CONNECTIONS

D [5] ———— [4] G
D [6] ———— [3] S
D [7] ———— [2] S
D [8] ———— [1] S

### ORDERING INFORMATION

### MOSFET MAXIMUM RATINGS ($T_A$ = 25°C, unless otherwise noted)

| Symbol | Parameter | Ratings | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | 30 | V |
| $V_{GS}$ | Gate to Source Voltage (Note 4) | ±20 | V |
| $I_D$ | Drain Current<br>– Continuous (Package Limited) $T_C$ = 25°C<br>– Continuous (Silicon Limited) $T_C$ = 25°C<br>– Continuous $T_A$ = 25°C (Note 1a)<br>– Pulsed | <br>42<br>83<br>19<br>90 | A |
| $E_{AS}$ | Single Pulse Avalanche Energy (Note 3) | 60 | mJ |
| $P_D$ | Power Dissipation<br>$T_C$ = 25°C<br>$T_A$ = 25°C (Note 1a) | <br>46<br>2.5 | W |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | –55 to +150 | °C |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

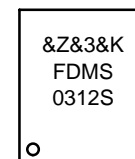### THERMAL CHARACTERISTICS ($T_A$ = 25°C, unless otherwise noted)

| Symbol | Parameter | Ratings | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | 2.7 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1a) | 50 | |

# FDMS0312S

**ELECTRICAL CHARACTERISTICS** ($T_J = 25°C$ unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D = 1$ mA, $V_{GS} = 0$ V | 30 | – | – | V |
| $\dfrac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 10$ mA, referenced to 25°C | – | 18 | – | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS} = 24$ V, $V_{GS} = 0$ V | – | – | 500 | µA |
| $I_{GSS}$ | Gate to Source Leakage Current, Forward | $V_{GS} = 20$ V, $V_{DS} = 0$ V | – | – | 100 | nA |
| **ON CHARACTERISTICS** (Note 2) | | | | | | |
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS} = V_{DS}$, $I_D = 1$ mA | 1.2 | 1.9 | 3.0 | V |
| $\dfrac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D = 10$ mA, referenced to 25°C | – | –5 | – | mV/°C |
| $r_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10$ V, $I_D = 18$ A | – | 3.6 | 4.9 | mΩ |
| | | $V_{GS} = 4.5$ V, $I_D = 14$ A | – | 4.7 | 5.8 | |
| | | $V_{GS} = 10$ V, $I_D = 18$ A, $T_J = 125°C$ | – | 5 | 6.2 | |
| $g_{FS}$ | Forward Transconductance | $V_{DS} = 5$ V, $I_D = 18$ A | – | 97 | – | S |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS} = 15$ V, $V_{GS} = 0$ V, $f = 1$ MHz | – | 2120 | 2820 | pF |
| $C_{oss}$ | Output Capacitance | | – | 735 | 975 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | – | 90 | 135 | pF |
| $R_g$ | Gate Resistance | | – | 1.1 | 2.2 | Ω |
| **SWITCHING CHARACTERISTICS** | | | | | | |
| $t_{d(on)}$ | Turn–On Delay Time | $V_{DD} = 15$ V, $I_D = 18$ A, $V_{GS} = 10$ V, $R_{GEN} = 6$ Ω | – | 12 | 21 | ns |
| $t_r$ | Rise Time | | – | 5 | 10 | ns |
| $t_{d(off)}$ | Turn–Off Delay Time | | – | 28 | 44 | ns |
| $t_f$ | Fall Time | | – | 4 | 10 | ns |
| $Q_g$ | Total Gate Charge | $V_{GS} = 0$ V to 10 V, $V_{DD} = 15$ V, $I_D = 18$ A | – | 33 | 46 | nC |
| $Q_g$ | Total Gate Charge | $V_{GS} = 0$ V to 4.5 V, $V_{DD} = 15$ V, $I_D = 18$ A | – | 15 | 22 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | $V_{DD} = 15$ V, $I_D = 18$ A | – | 6.5 | – | nC |
| $Q_{gd}$ | Gate to Drain "Miller" Charge | | – | 4.0 | – | nC |
| **DRAIN–SOURCE DIODE CHARACTERISTICS** | | | | | | |
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS} = 0$ V, $I_S = 2$ A (Note 2) | – | 0.48 | 0.7 | V |
| | | $V_{GS} = 0$ V, $I_S = 18$ A (Note 2) | – | 0.80 | 1.2 | |
| $t_{rr}$ | Reverse Recovery Time | $I_F = 18$ A, di/dt = 300 A/µs | – | 26 | 42 | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | – | 26 | 42 | nC |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

1. $R_{\theta JA}$ is determined with the device mounted on a 1in² pad 2 oz copper pad on a 1.5 x 1.5 in. board of FR–4 material. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.
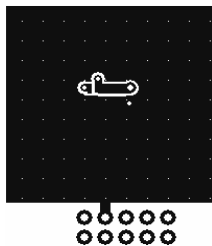


a. 50°C/W when mounted on a 1 in² pad of 2 oz copper.



b. 125°C/W when mounted on a minimum pad of 2 oz copper.

2. Pulse Test: Pulse Width < 300 µs, Duty cycle < 2.0%.
3. $E_{AS}$ of 60 mJ is based on starting $T_J = 25°C$, L = 1 mH, $I_{AS} = 11$ A, $V_{DD} = 27$ V, $V_{GS} = 10$ V. 100% test at L = 0.3 mH, $I_{AS} = 16$ A.
4. As an N–ch device, the negative Vgs rating is for low duty cycle pulse occurrence only. No continuous rating is implied.
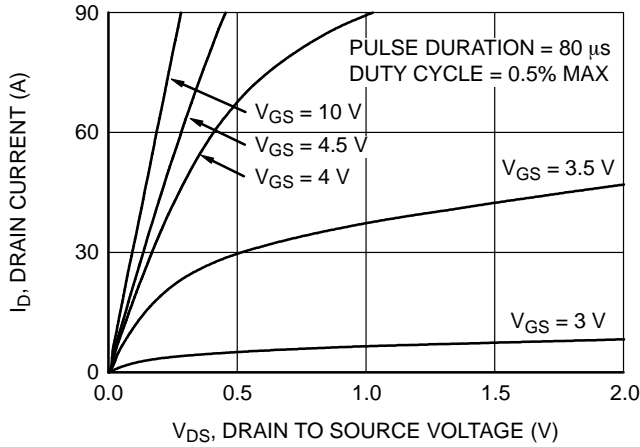
## TYPICAL CHARACTERISTICS

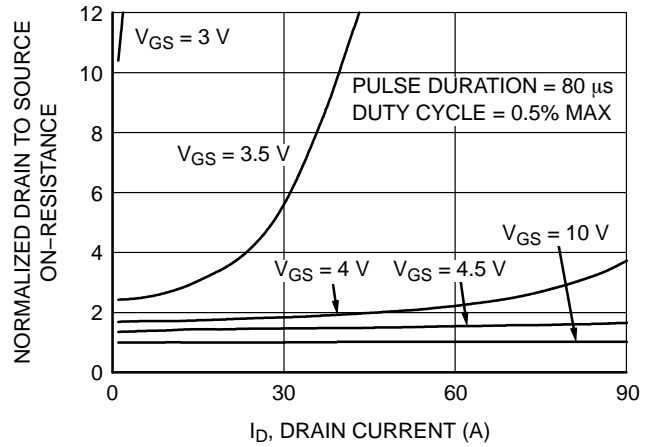($T_J$ = 25°C UNLESS OTHERWISE NOTED)

**Figure 1. On−Region Characteristics**

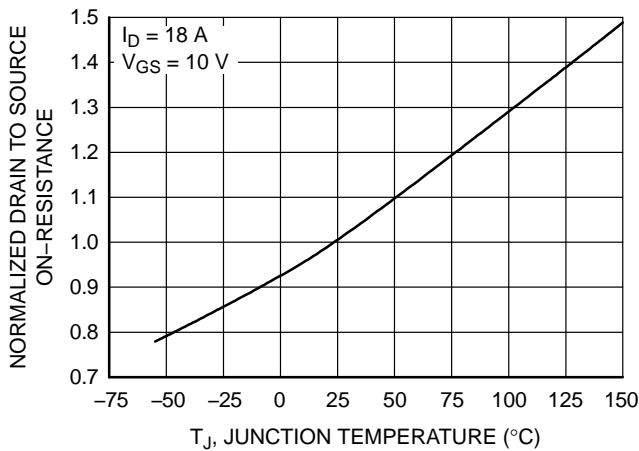**Figure 2. Normalized On−Resistance vs. Drain Current and Gate Voltage**

**Figure 3. Normalized On−Resistance vs. Junction Temperature**
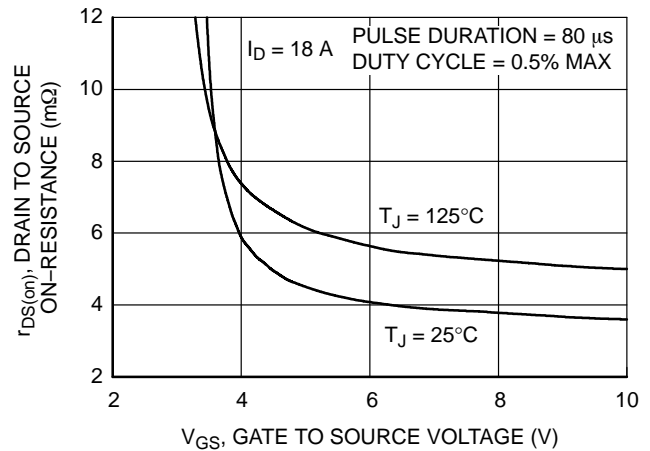
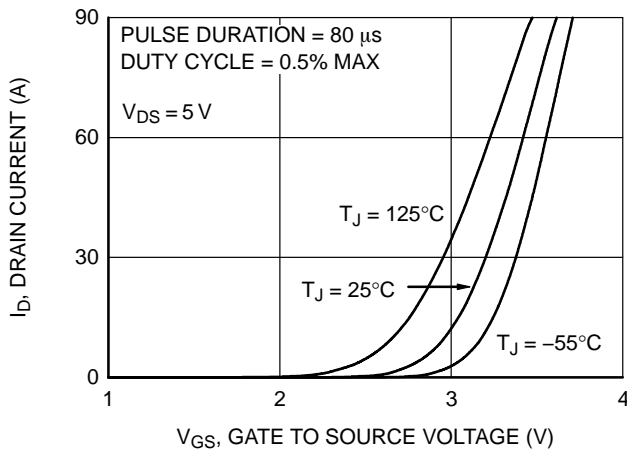**Figure 4. On−Resistance vs. Gate to Source Voltage**
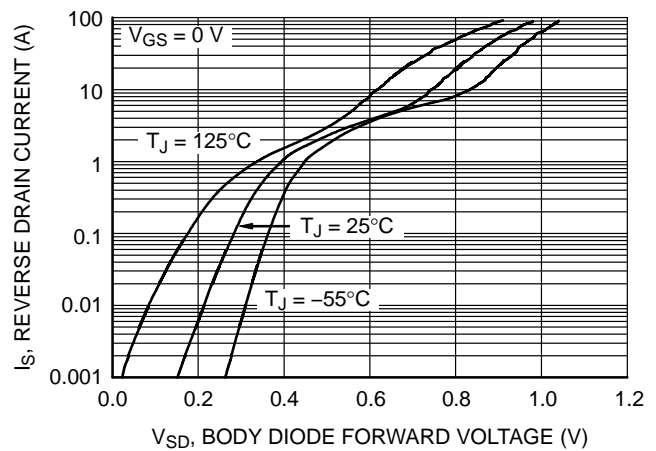
**Figure 5. Transfer Characteristics**

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

## TYPICAL CHARACTERISTICS
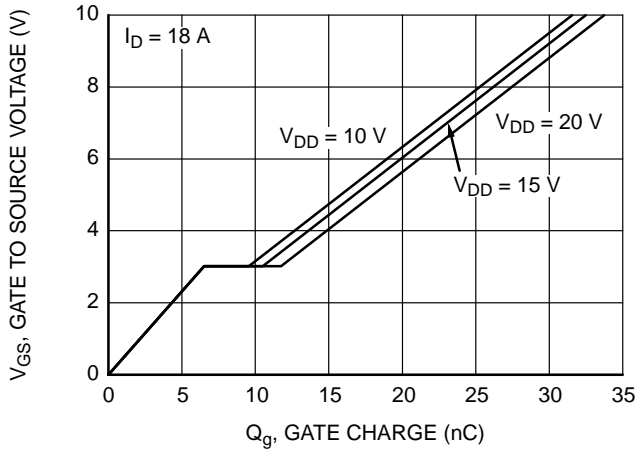
($T_J$ = 25°C UNLESS OTHERWISE NOTED) (CONTINUED)



**Figure 7. Gate Charge Characteristics**
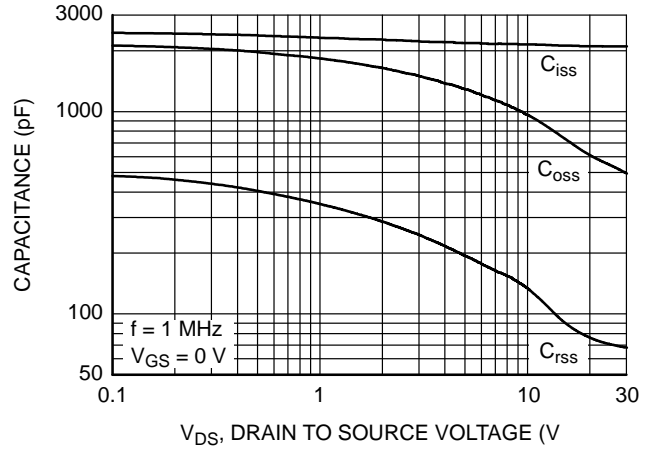


**Figure 8. Capacitance vs. Drain to Source Voltage**
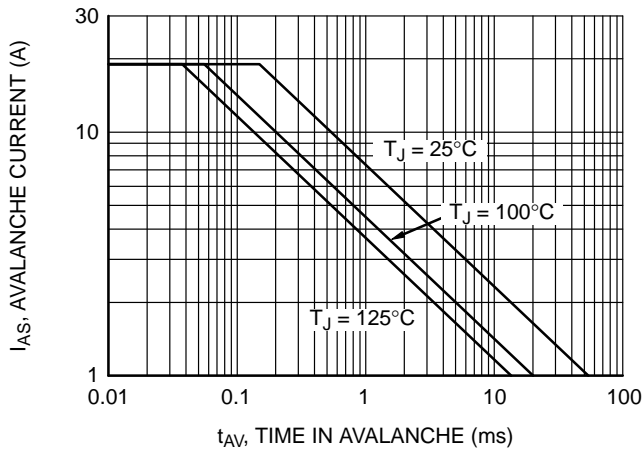


**Figure 9. Unclamped Inductive Switching Capability**
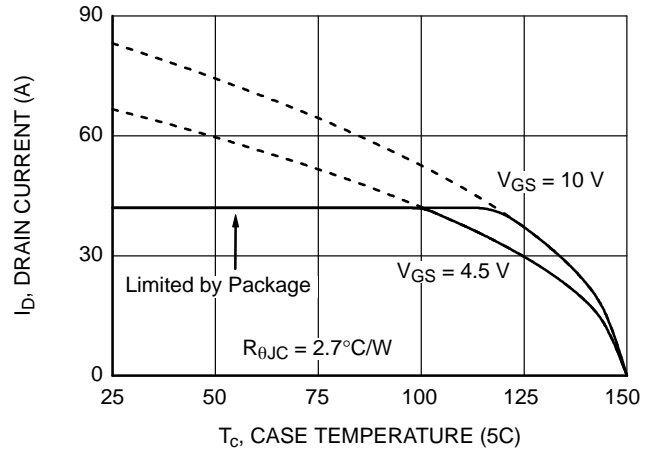


**Figure 10. Maximum Continuous Drain Current vs. Case Temperature**
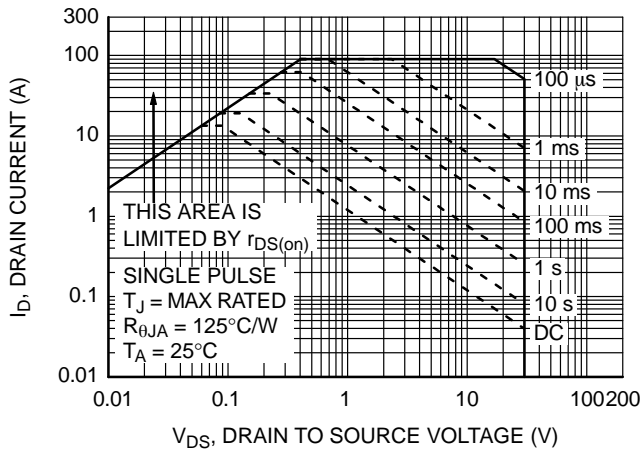


**Figure 11. Forward Bias Safe Operating Area**
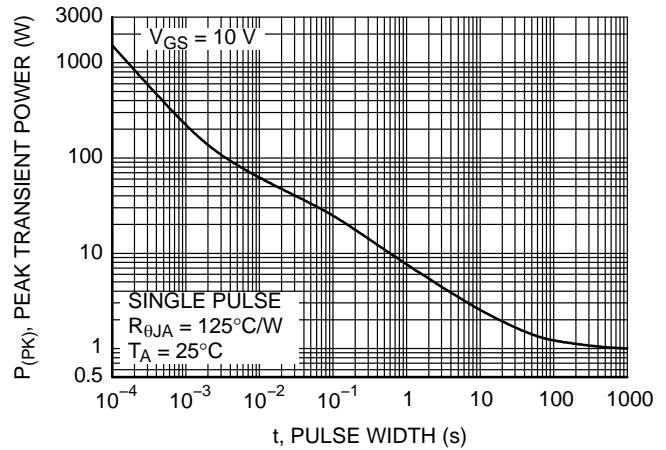


**Figure 12. Single Pulse Maximum Power Dissipation**

## TYPICAL CHARACTERISTICS

(T$_J$ = 25°C UNLESS OTHERWISE NOTED) (CONTINUED)
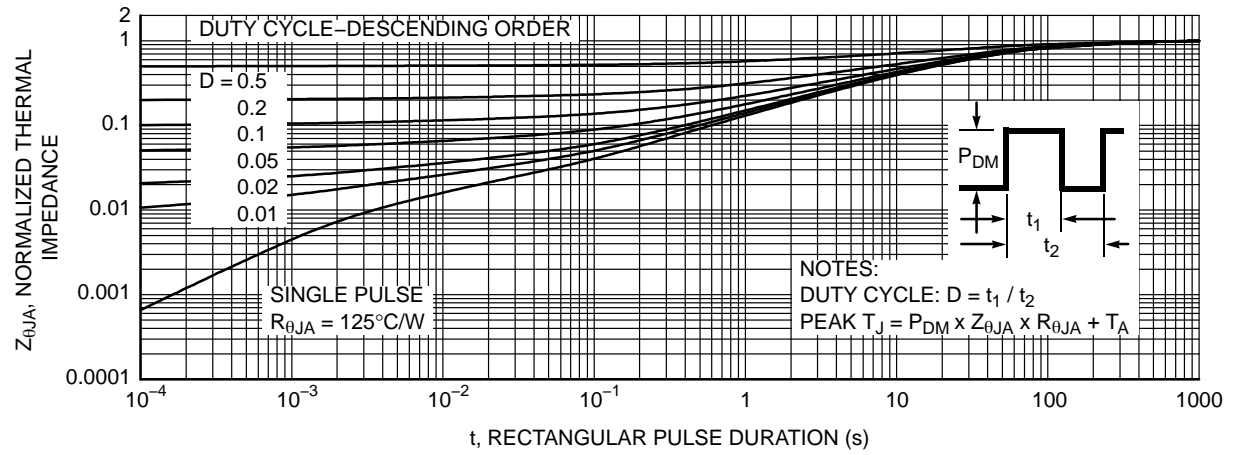


**Figure 13. Junction−to−Ambient Transient Thermal Response Curve**

## TYPICAL CHARACTERISTICS (CONTINUED)

**SyncFET Schottky Body Diode Characteristics**

**onsemi**'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 reverses recovery characteristic of the FDMS0312S.

Schottky barrier diodes exhibit significant leakage at high temperature and high reverse voltage. This will increase the power in the device.
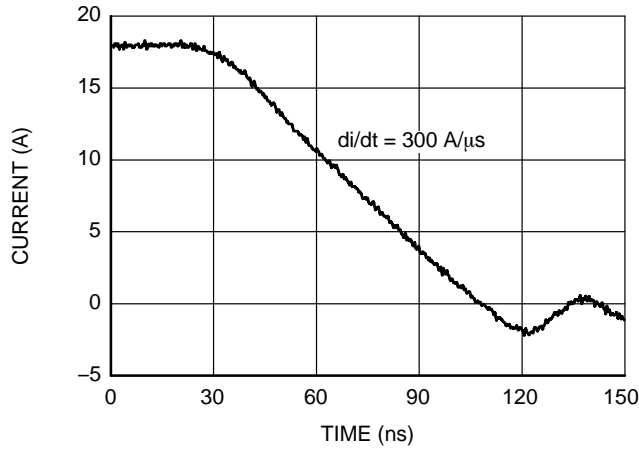
**Figure 14. FDMS0312S SyncFET Body Diode Reverse Recovery Characteristic**
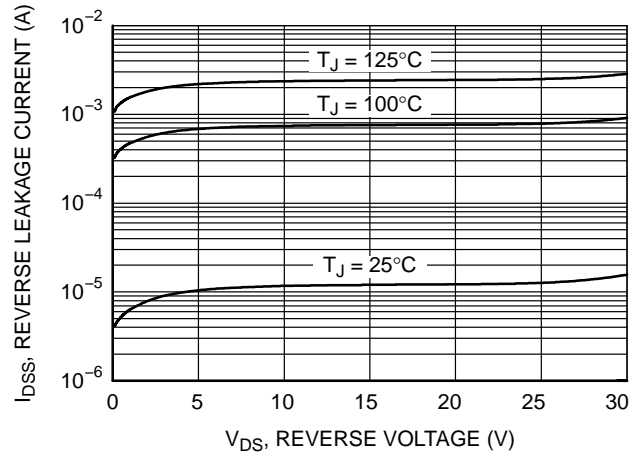
**Figure 15. SyncFET Body Diode Reverses Leakage vs. Drain–Source Voltage**

## PACKAGE MARKING AND ORDERING INFORMATION

| Device | Device Marking | Package Type | Reel Size | Tape Width | Shipping[†] |
|--------|----------------|--------------|-----------|------------|-------------|
| FDMS0312S | FDMS0312S | PQFN8 5X6, 1.27P (Power 56) (Pb–Free, Halide Free) | 13" | 12 mm | 3000 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.
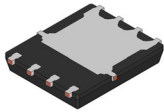
**PQFN8 5X6, 1.27P**
CASE 483AE
ISSUE C

DATE 21 JAN 2022

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. COPLANARITY APPLIES TO THE EXPOSED PADS AS WELL AS THE TERMINALS.
4. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.
5. SEATING PLANE IS DEFINED BY THE TERMINALS. "A1" IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.
6. IT IS RECOMMENDED TO HAVE NO TRACES OR VIAS WITHIN THE KEEP OUT AREA.

TOP VIEW

SEE DETAIL B

OPTIONAL DRAFT ANGLE MAY APPEAR ON FOUR SIDES OF THE PACKAGE

PIN 1 AREA

SEE DETAIL C
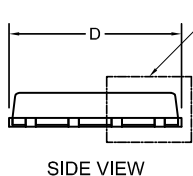
SIDE VIEW
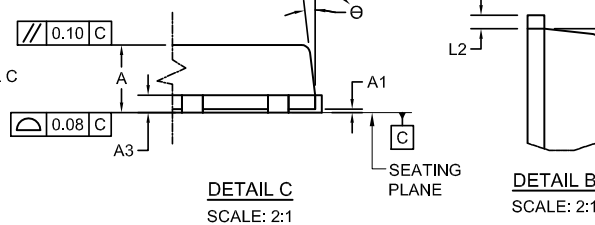
DETAIL C
SCALE: 2:1

DETAIL B
SCALE: 2:1

SEATING PLANE
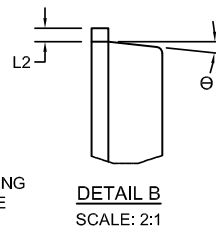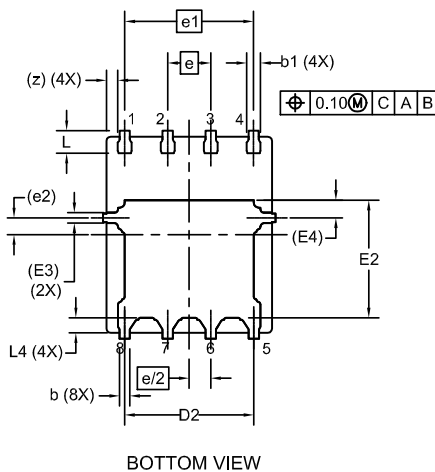
BOTTOM VIEW
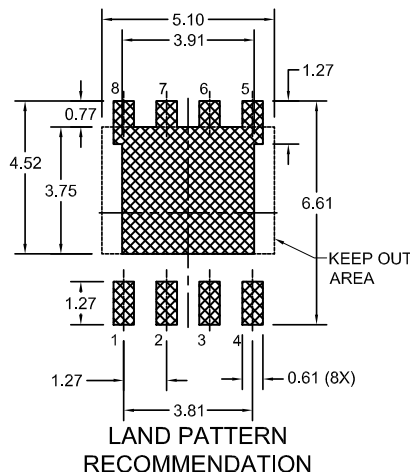
LAND PATTERN RECOMMENDATION

KEEP OUT AREA

*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

| DIM | MILLIMETERS | | |
|-----|------|------|------|
| | MIN. | NOM. | MAX. |
| A | 0.90 | 1.00 | 1.10 |
| A1 | 0.00 | - | 0.05 |
| b | 0.21 | 0.31 | 0.41 |
| b1 | 0.31 | 0.41 | 0.51 |
| A3 | 0.15 | 0.25 | 0.35 |
| D | 4.90 | 5.00 | 5.20 |
| D1 | 4.80 | 4.90 | 5.00 |
| D2 | 3.61 | 3.82 | 3.96 |
| E | 5.90 | 6.15 | 6.25 |
| E1 | 5.70 | 5.80 | 5.90 |
| E2 | 3.38 | 3.48 | 3.78 |
| E3 | 0.30 REF | | |
| E4 | 0.52 REF | | |
| e | 1.27 BSC | | |
| e/2 | 0.635 BSC | | |
| e1 | 3.81 BSC | | |
| e2 | 0.50 REF | | |
| L | 0.51 | 0.66 | 0.76 |
| L2 | 0.05 | 0.18 | 0.30 |
| L4 | 0.34 | 0.44 | 0.54 |
| z | 0.34 REF | | |
| $\Theta$ | 0° | - | 12° |

| DOCUMENT NUMBER: | 98AON13655G | | |
|---|---|---|---|
| DESCRIPTION: | PQFN8 5X6, 1.27P | | PAGE 1 OF 1 |

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www.onsemi.com/support/sales

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