**FAIRCHILD**

SEMICONDUCTOR®

# FDMS7658AS

## N-Channel PowerTrench® SyncFET™

## 30 V, 49 A, 1.9 mΩ

### Features

- Max $r_{DS(on)}$ = 1.9 mΩ at $V_{GS}$ = 10 V, $I_D$ = 28 A

- Max $r_{DS(on)}$ = 2.2 mΩ at $V_{GS}$ = 7 V, $I_D$ = 26 A

- Advanced Package and Silicon combination for low $r_{DS(on)}$ and high efficiency

- SyncFET Schottky Body Diode

- MSL1 robust package design

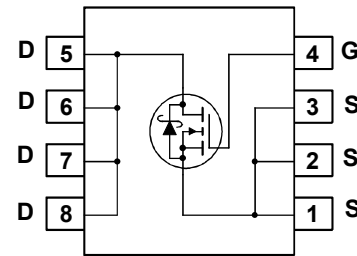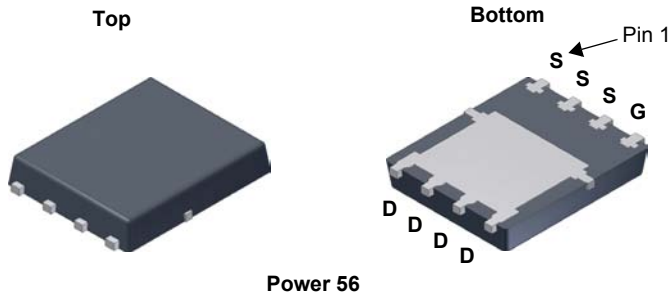- 100% UIL tested

- RoHS Compliant

### General Description

The FDMS7658AS 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.

### Applications

- Synchronous Rectifier for DC/DC Converters

- Notebook Vcore/ GPU low side switch

- Networking Point of Load low side switch

- Telecom secondary side rectification

**Top**   **Bottom**   Pin 1

S S S G

D D D D

**Power 56**

| D | 5 | | 4 | G |
| D | 6 | | 3 | S |
| D | 7 | | 2 | S |
| D | 8 | | 1 | S |

## 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 | | 49 | A |
| | -Continuous (Silicon limited) | $T_C$ = 25 °C | | 177 | |
| | -Continuous | $T_A$ = 25 °C | (Note 1a) | 29 | |
| | -Pulsed | | | 150 | |
| dv/dt | MOSFET dv/dt | | | 1.5 | V/ns |
| $E_{AS}$ | Single Pulse Avalanche Energy | | (Note 3) | 162 | mJ |
| $P_D$ | Power Dissipation | $T_C$ = 25 °C | | 89 | W |
| | Power Dissipation | $T_A$ = 25 °C | (Note 1a) | 2.5 | |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | | | -55 to +150 | °C |

### Thermal Characteristics

| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | | 1.4 | °C/W |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1a) | 50 | |

### Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FDMS7658AS | FDMS7658AS | Power 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** | | | | | | |
| $BV_{DSS}$ | 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 | | 23 | | 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 | 1.7 | 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, $I_D$ = 28 A | | 1.5 | 1.9 | mΩ |
| | | $V_{GS}$ = 7 V, $I_D$ = 26 A | | 1.7 | 2.2 | |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 23 A | | 1.9 | 2.4 | |
| | | $V_{GS}$ = 10 V, $I_D$ = 28 A, $T_J$ = 125 °C | | 2.0 | 2.6 | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 5 V, $I_D$ = 28 A | | 181 | | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 15 V, $V_{GS}$ = 0 V, f = 1 MHz | | 5525 | 7350 | pF |
| $C_{oss}$ | Output Capacitance | | | 2020 | 2685 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 150 | 230 | pF |
| $R_g$ | Gate Resistance | | | 0.4 | 0.9 | Ω |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 15 V, $I_D$ = 28 A, $V_{GS}$ = 10 V, $R_{GEN}$ = 6 Ω | | 20 | 36 | ns |
| $t_r$ | Rise Time | | | 8 | 17 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 43 | 70 | ns |
| $t_f$ | Fall Time | | | 5 | 10 | ns |
| $Q_g$ | Total Gate Charge | $V_{GS}$ = 0 V to 10 V | | 78 | 109 | nC |
| $Q_g$ | Total Gate Charge | $V_{GS}$ = 0 V to 4.5 V | $V_{DD}$ = 15 V, $I_D$ = 28 A | 35 | 49 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | | 16.4 | | nC |
| $Q_{gd}$ | Gate to Drain "Miller" Charge | | | 6.6 | | nC |
| **Drain-Source Diode Characteristics** | | | | | | |
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 2 A    (Note 2) | | 0.38 | 0.9 | V |
| | | $V_{GS}$ = 0 V, $I_S$ = 28 A    (Note 2) | | 0.74 | 1.3 | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 28 A, di/dt = 300 A/µs | | 46 | 75 | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 73 | 117 | nC |

Notes:
1. $R_{θJA}$ is determined with the device mounted on a 1in$^2$ pad 2 oz copper pad on a 1.5 x 1.5 in. board of FR-4 material. $R_{θJC}$ is guaranteed by design while $R_{θCA}$ is determined by the user's board design.
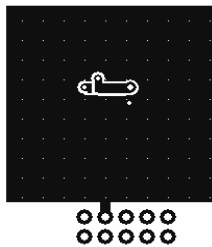


a. 50 °C/W when mounted on a 1 in$^2$ pad of 2 oz copper.
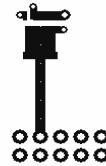
b. 125 °C/W when mounted on a minimum pad of 2 oz copper.

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

3. $E_{AS}$ of 162 mJ is based on starting $T_J$ = 25 °C, L = 1 mH, $I_{AS}$ = 18 A, $V_{DD}$ = 27 V, $V_{GS}$ = 10 V. 100% test at L = 0.3 mH, $I_{AS}$ = 28 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
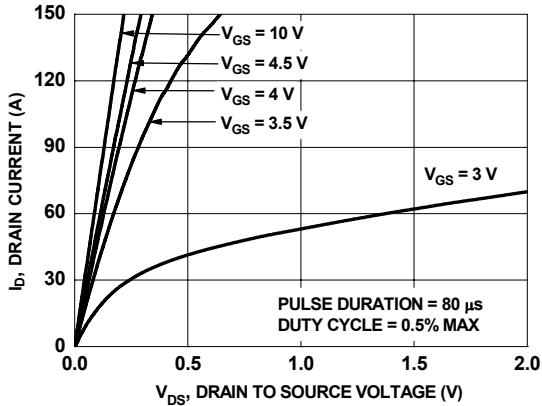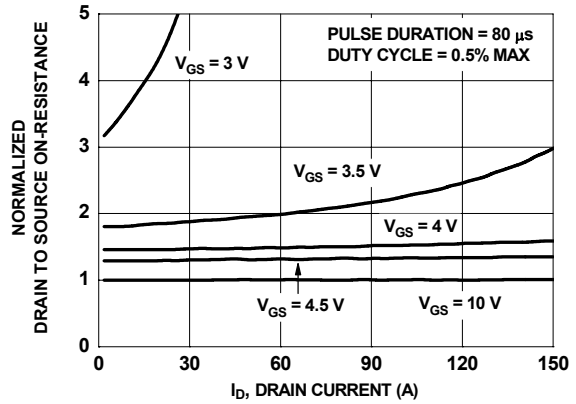
**Figure 1. On-Region Characteristics**

**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**
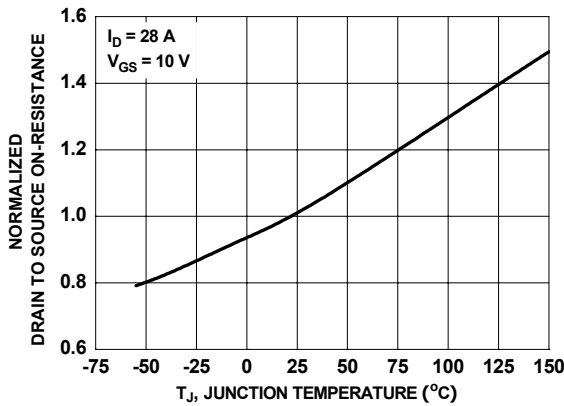
**Figure 3. Normalized On-Resistance vs Junction Temperature**
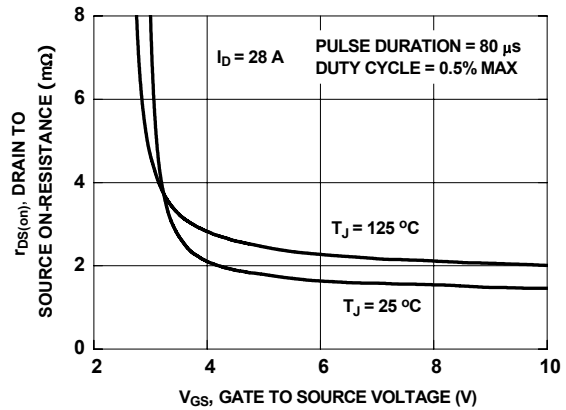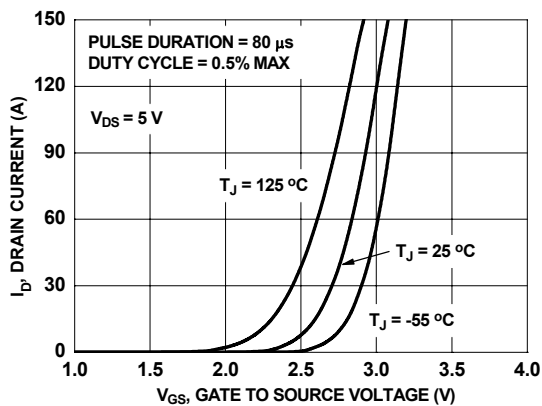
**Figure 4. On-Resistance vs Gate to Source Voltage**

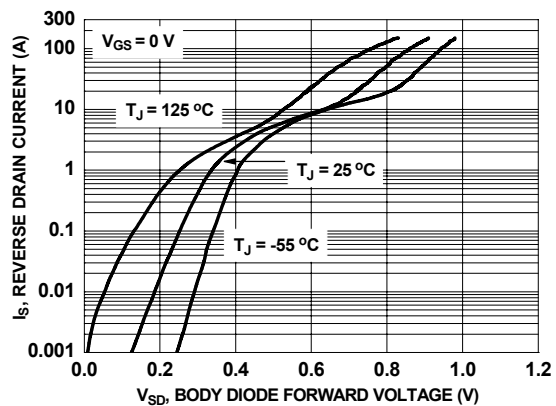**Figure 5. Transfer Characteristics**

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

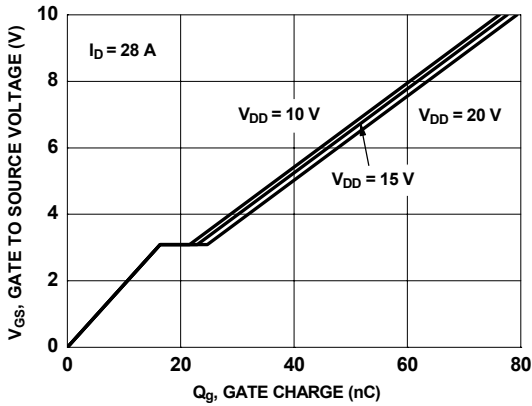## Typical Characteristics $T_J$ = 25 °C unless otherwise noted



**Figure 7. Gate Charge Characteristics**
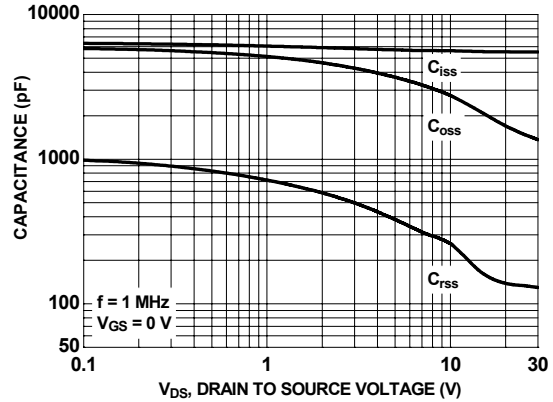


**Figure 8. Capacitance vs Drain to Source Voltage**
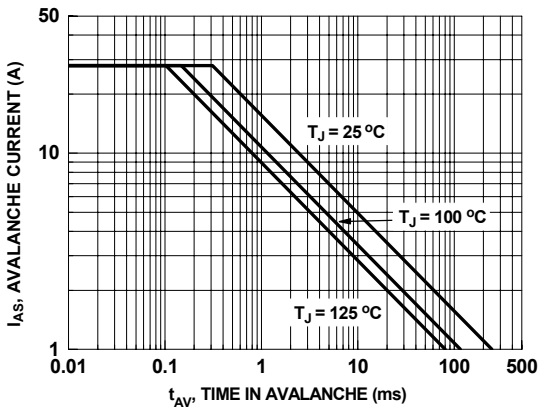


**Figure 9. Unclamped Inductive Switching Capability**
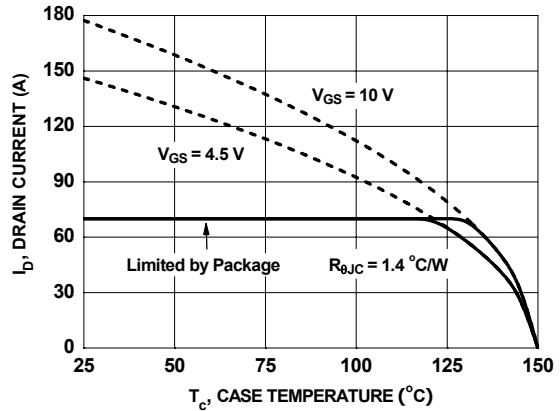


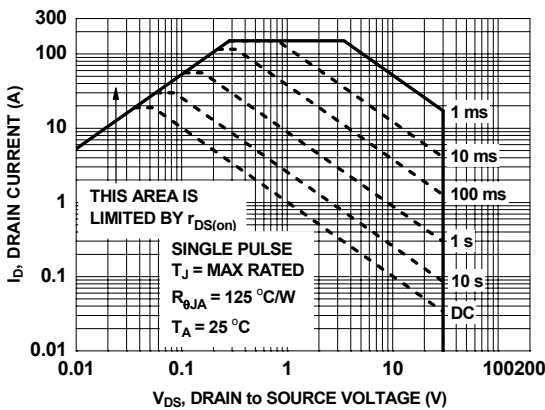**Figure 10. Maximum Continuous Drain Current vs Case Temperature**
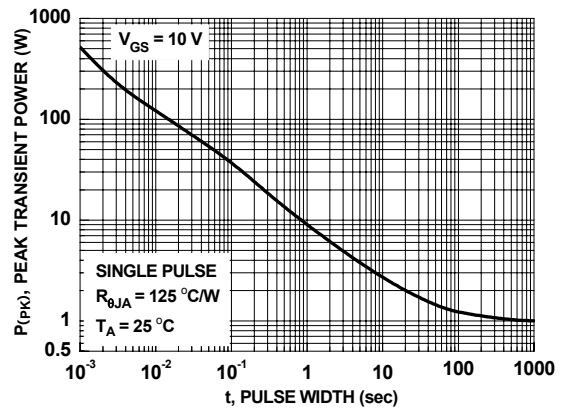


**Figure 11. Forward Bias Safe Operating Area**



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

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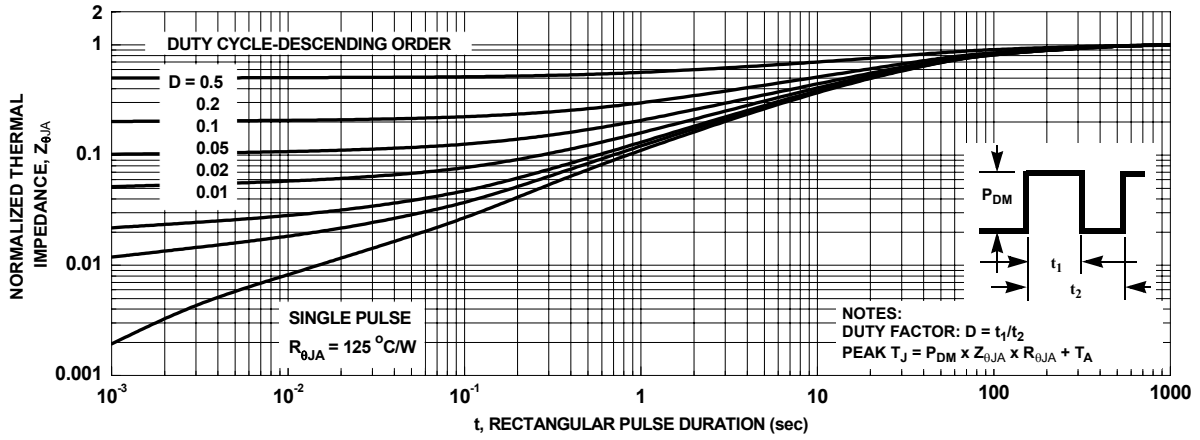


**Figure 13. Junction-to-Ambient Transient Thermal Response Curve**

## 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 reverses recovery characteristic of the FDMS7658AS.

Schottky barrier diodes exhibit significant leakage at high temperature and high reverse voltage. This will increase the power in the device.
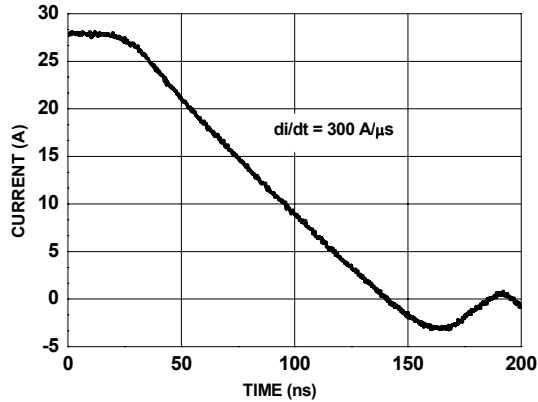
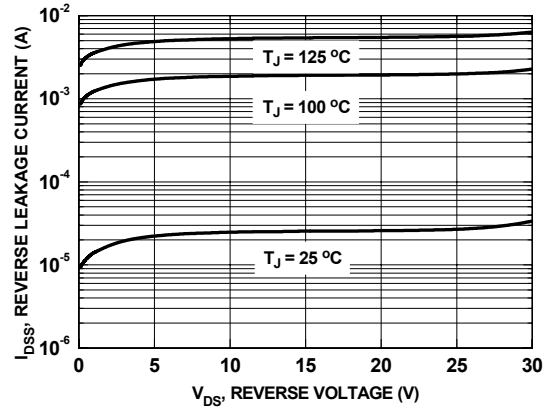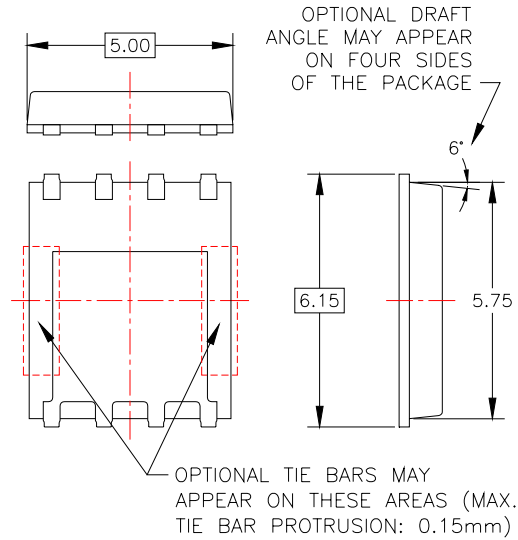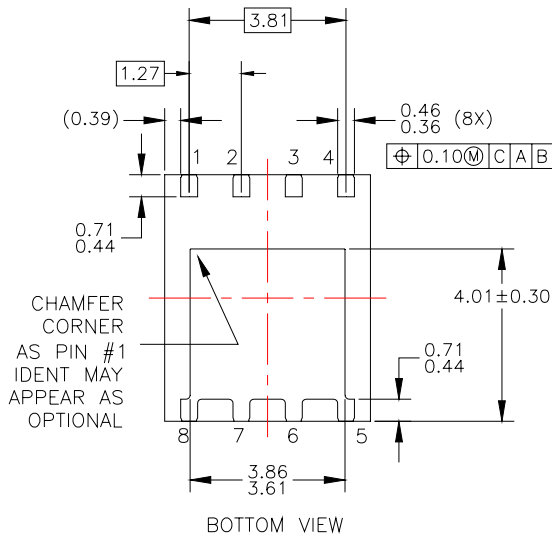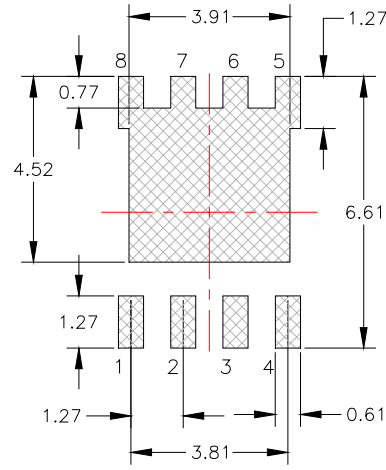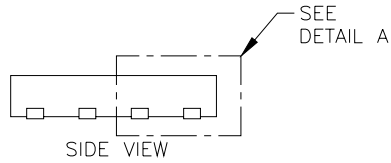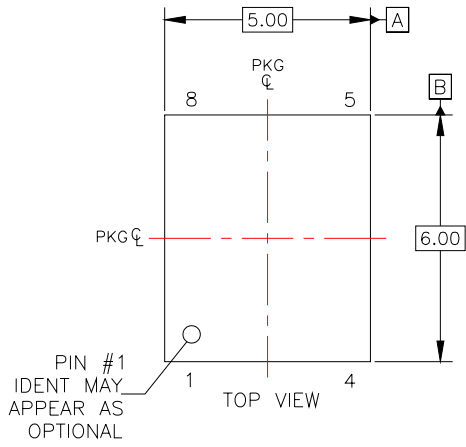Figure 14. FDMS7658AS SyncFET body diode reverse recovery characteristic

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

## Dimensional Outline and Pad Layout

5.00  A

PKG ℄

8   5

B

PKG ℄   6.00

PIN #1
IDENT MAY
APPEAR AS
OPTIONAL

1   4

TOP VIEW

SEE
DETAIL A

SIDE VIEW

3.91   1.27

8  7  6  5

0.77

4.52   6.61

1.27

1  2  3  4

1.27   0.61

3.81

LAND PATTERN
RECOMMENDATION

3.81

1.27

(0.39)   0.46
0.36  (8X)

1  2   3  4   ⊕ 0.10Ⓜ C A B

0.71
0.44

CHAMFER
CORNER
AS PIN #1
IDENT MAY
APPEAR AS
OPTIONAL

4.01±0.30

0.71
0.44

8  7  6   5

3.86
3.61

BOTTOM VIEW

5.00

OPTIONAL DRAFT
ANGLE MAY APPEAR
ON FOUR SIDES
OF THE PACKAGE

6°

6.15   5.75

OPTIONAL TIE BARS MAY
APPEAR ON THESE AREAS (MAX.
TIE BAR PROTRUSION: 0.15mm)

// 0.10 C

⌓ 0.08 C

0.30
0.20

0.05
0.00

C

1.10
0.90

SEATING
PLANE

DETAIL A
SCALE: 2:1

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)   DRAWING FILE NAME: PQFN08AREV4
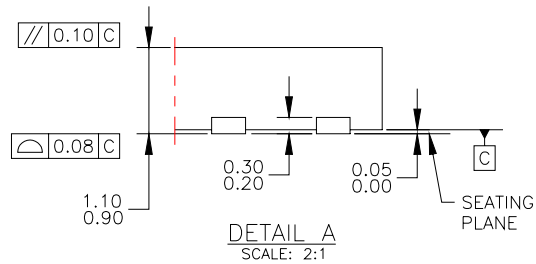
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|---|---|---|
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