# MOSFET – Dual, N-Channel, Asymmetric, POWERTRENCH®, Power Clip, 30 V

# FDPC5018SG

## General Description

This device includes two specialized N-Channel MOSFETs in a dual package. The switch node has been internally connected to enable easy placement and routing of synchronous buck converters. The control MOSFET (Q1) and synchronous SyncFET™ (Q2) have been designed to provide optimal power efficiency.

## Features

Q1: N-Channel

- Max $R_{DS(on)}$ = 5.0 mΩ at $V_{GS}$ = 10 V, $I_D$ = 17 A
- Max $R_{DS(on)}$ = 6.5 mΩ at $V_{GS}$ = 4.5 V, $I_D$ = 14 A

Q2: N-Channel

- Max $R_{DS(on)}$ = 1.6 mΩ at $V_{GS}$ = 10 V, $I_D$ = 32 A
- Max $R_{DS(on)}$ = 2.0 mΩ at $V_{GS}$ = 4.5 V, $I_D$ = 28 A
- Low Inductance Packaging Shortens Rise/Fall Times, Resulting in Lower Switching Losses.
- MOSFET Integration Enables Optimum Layout for Lower Circuit Inductance and Reduced Switch Node Ringing.
- ESD Protection Level: HBM > 500 V, CDM > 1 kV, MM > 100 V
- RoHS Compliant

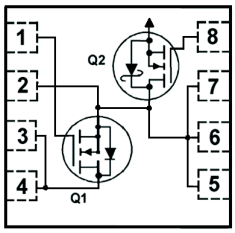
## Applications

- Computing
- Communications
- General Purpose Point of Load

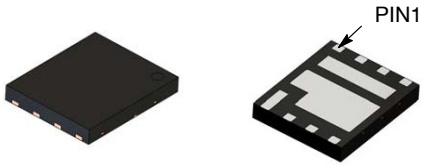
**Table 1. PIN DESCRIPTION**

| Pin | Name | Description |
|---|---|---|
| 1 | HSG | High Side Gate |
| 2 | GR | Gate Return |
| 3, 4, 9 | V+(HSD) | High Side Drain |
| 5, 6, 7 | SW | Switching Node, Low Side Drain |
| 8 | LSG | Low Side Gate |
| 10 | GND (LSS) | Low Side Source |

## ELECTRICAL CONNECTION



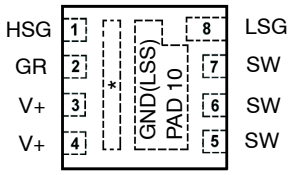

N-Channel MOSFET




Top View Bottom View

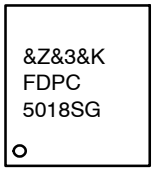
**Power Clip 56**
**(PQFN8 5x6)**
**CASE 483AR**

## PIN ASSIGNMENT




*PAD 9 V+(HSD)

## MARKING DIAGRAM




| | |
|---|---|
| &Z | = Assembly Plant Code |
| &3 | = Date Code (Year & Week) |
| &K | = Lot Traceability Code |
| FDPC5018SG | = Specific Device Code |

## ORDERING INFORMATION

See detailed ordering and shipping information on page 11 of this data sheet.

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**MOSFET MAXIMUM RATINGS** ($T_A$ = 25°C, Unless otherwise noted.)

| Symbol | Parameter | Q1 | Q2 | Unit |
|---|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | 30 | 30 | V |
| Bvdsst | Bvdsst (Transient) < 100 ns | 32.5 | 32.5 | V |
| $V_{GS}$ | Gate to Source Voltage | ±20 | ±12 | V |
| $I_D$ | Drain Current<br>– Continuous ($T_C$ = 25°C) (Note 5) | 56 | 109 | A |
| | – Continuous ($T_C$ = 100°C) (Note 5) | 35 | 69 | |
| | – Continuous ($T_A$ = 25°C) | 17 (Note 1a) | 32 (Note 1b) | |
| | – Pulsed ($T_A$ = 25°C) (Note 4) | 227 | 704 | |
| $E_{AS}$ | Single Pulsed Avalanche Energy (Note 3) | 54 | 181 | mJ |
| $P_D$ | Power Dissipation for Single Operation<br>($T_C$ = 25°C)<br>($T_A$ = 25°C)<br>($T_A$ = 25°C) | 23<br>2.1 (Note 1a)<br>1.0 (Note 1c) | 29<br>2.3 (Note 1b)<br>1.1 (Note 1d) | 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**

| Symbol | Parameter | Q1 | Q2 | Unit |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | 5.6 | 4.3 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 60 (Note 1a) | 55 (Note 1b) | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 130 (Note 1c) | 120 (Note 1d) | °C/W |

**Table 2. ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise noted.)

| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = 250 μA, $V_{GS}$ = 0 V<br>$I_D$ = 1 mA, $V_{GS}$ = 0 V | Q1<br>Q2 | 30<br>30 | –<br>– | –<br>– | V |
| $\Delta BV_{DSS}$ / $\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, referenced to 25°C<br>$I_D$ = 10 mA, referenced to 25°C | Q1<br>Q2 | –<br>– | 15<br>19 | –<br>– | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 24 V, $V_{GS}$ = 0 V<br>$V_{DS}$ = 24 V, $V_{GS}$ = 0 V | Q1<br>Q2 | –<br>– | –<br>– | 1<br>500 | μA<br>μA |
| $I_{GSS}$ | Gate to Source Leakage Current, Forward | $V_{GS}$ = 20 V, $V_{DS}$= 0 V<br>$V_{GS}$ = 12 V, $V_{DS}$= 0 V | Q1<br>Q2 | –<br>– | –<br>– | 100<br>100 | nA<br>nA |
| **ON CHARACTERISTICS** | | | | | | | |
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA<br>$V_{GS}$ = $V_{DS}$, $I_D$ = 1 mA | Q1<br>Q2 | 1.0<br>1.0 | 1.7<br>1.6 | 3.0<br>3.0 | V |
| $\Delta V_{GS(th)}$ / $\Delta T_J$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D$ = 250 μA, referenced to 25°C<br>$I_D$ = 10 mA, referenced to 25°C | Q1<br>Q2 | –<br>– | –5<br>–3 | –<br>– | mV/°C |
| $R_{DS(on)}$ | Drain to Source On Resistance | $V_{GS}$ = 10 V, $I_D$ = 17 A<br>$V_{GS}$ = 4.5 V, $I_D$ = 14 A<br>$V_{GS}$ = 10 V, $I_D$ = 17 A, $T_J$ = 125°C | Q1 | –<br>– | 4.1<br>5.4<br>5.7 | 5.0<br>6.5<br>7.0 | mΩ |
| | | $V_{GS}$ = 10 V, $I_D$ = 32 A<br>$V_{GS}$ = 4.5 V, $I_D$ = 28 A<br>$V_{GS}$ = 10 V, $I_D$ = 32 A, $T_J$ = 125°C | Q2 | –<br>– | 1.4<br>1.7<br>2.1 | 1.6<br>2.0<br>2.4 | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 5 V, $I_D$ = 17 A<br>$V_{DS}$ = 5 V, $I_D$ = 32 A | Q1<br>Q2 | –<br>– | 93<br>188 | –<br>– | S |



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**Table 2. ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise noted.)(continued)

| Symbol | Parameter | Test Conditions | | Type | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|---|
| **DYNAMIC CHARACTERISTICS** | | | | | | | | |
| $C_{iss}$ | Input Capacitance | Q1: $V_{DS}$ = 15 V, $V_{GS}$ = 0 V, f = 1 MHz<br>Q2: $V_{DS}$ = 15 V, $V_{GS}$ = 0 V, f = 1 MHz | | Q1<br>Q2 | –<br>– | 1224<br>4593 | 1715<br>6430 | pF |
| $C_{oss}$ | Output Capacitance | | | Q1<br>Q2 | –<br>– | 397<br>1210 | 560<br>1695 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | Q1<br>Q2 | –<br>– | 42<br>80 | 60<br>115 | pF |
| $R_g$ | Gate Resistance | | | Q1<br>Q2 | 0.1<br>0.1 | 0.5<br>0.8 | 1.5<br>2.4 | Ω |
| **SWITCHING CHARACTERISTICS** | | | | | | | | |
| $t_{d(on)}$ | Turn−On Delay Time | Q1: $V_{DD}$ = 15 V, $I_D$ = 17 A, $R_{GEN}$ = 6 Ω<br>Q2: $V_{DD}$ = 15 V, $I_D$ = 32 A, $R_{GEN}$ = 6 Ω | | Q1<br>Q2 | –<br>– | 8<br>14 | 16<br>25 | ns |
| $t_r$ | Rise Time | | | Q1<br>Q2 | –<br>– | 2<br>5 | 10<br>10 | ns |
| $t_{d(off)}$ | Turn−Off Delay Time | | | Q1<br>Q2 | –<br>– | 18<br>38 | 33<br>61 | ns |
| $t_f$ | Fall Time | | | Q1<br>Q2 | –<br>– | 2<br>4 | 10<br>10 | ns |
| $Q_g$ | Total Gate Charge | $V_{GS}$ = 0 V to 10 V | Q1<br>$V_{DD}$ = 15 V,<br>$I_D$ = 17 A<br>Q2<br>$V_{DD}$ = 15 V,<br>$I_D$ = 32 A | Q1<br>Q2 | –<br>– | 17<br>62 | 24<br>87 | nC |
| $Q_g$ | Total Gate Charge | $V_{GS}$ = 0 V to 4.5 V | | Q1<br>Q2 | –<br>– | 8<br>28 | 11<br>40 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | | Q1<br>Q2 | –<br>– | 3.1<br>11 | –<br>– | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | | Q1<br>Q2 | –<br>– | 2.0<br>5.3 | –<br>– | nC |
| **DRAIN−SOURCE DIODE CHARACTERISTICS** | | | | | | | | |
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 17 A (Note 2)<br>$V_{GS}$ = 0 V, $I_S$ = 32 A (Note 2) | | Q1<br>Q2 | –<br>– | 0.8<br>0.8 | 1.2<br>1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | Q1<br>$I_F$ = 17 A, di/dt = 100 A/μs<br>Q2<br>$I_F$ = 32 A, di/dt = 240 A/μs | | Q1<br>Q2 | –<br>– | 23<br>32 | 37<br>51 | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | Q1<br>Q2 | –<br>– | 8<br>40 | 16<br>64 | 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.



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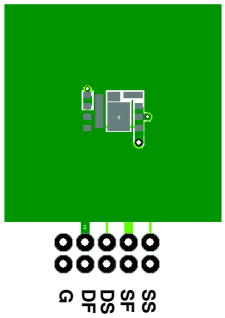
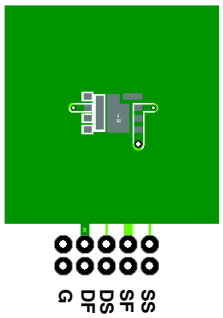
NOTES:

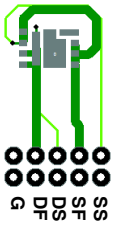
1. $R_{\theta JA}$ is determined with the device mounted on a 1 $in^2$ pad 2 oz copper pad on a 1.5 × 1.5 in. board of FR−4 material. $R_{\theta CA}$ is determined by the user's board design.



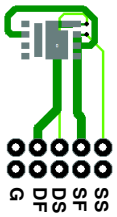

a) 60°C/W when mounted on a 1 $in^2$ pad of 2 oz copper.




b) 55°C/W when mounted on a 1 $in^2$ pad of 2 oz copper.




c) 130°C/W when mounted on a minimum pad of 2 oz copper.




d) 120°C/W when mounted on a minimum pad of 2 oz copper.

2. Pulse Test: Pulse Width < 300 μs, Duty cycle < 2.0%.
3. Q1: $E_{AS}$ of 54 mJ is based on starting $T_J$ = 25°C; L = 3 mH, $I_{AS}$ = 6 A, $V_{DD}$ = 30 V. $V_{GS}$ = 10 V, 100% tested at L = 0.1 mH, $I_{AS}$ = 20 A.
   Q2: $E_{AS}$ of 181 mJ is based on starting $T_J$ = 25°C; L = 3 mH, $I_{AS}$ = 11 A, $V_{DD}$ = 30 V. $V_{GS}$ = 10 V, 100% tested at L = 0.1 mH, $I_{AS}$ = 36 A.
4. Pulsed Id refer to Figure 11 and Figure 24 SOA graphs for more details.
5. Computed continuous current limited to Max Junction Temperature only, actual continuous current will be limited by thermal & electro-mechanical application board design.



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## TYPICAL CHARACTERISTICS (Q1 N-CHANNEL)

($T_J$ = 25°C unless otherwise noted)

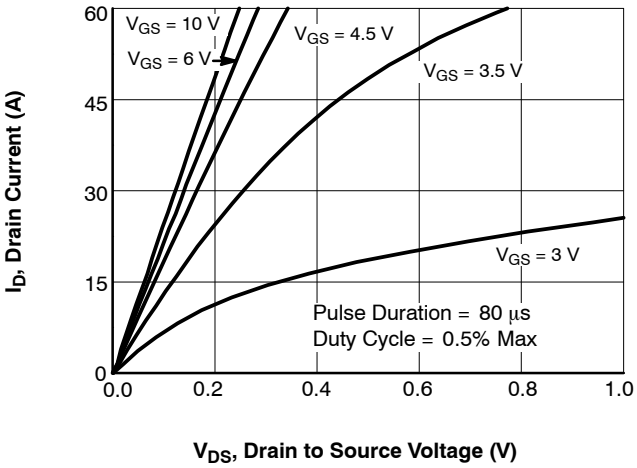


**Figure 1. On−Region Characteristics**

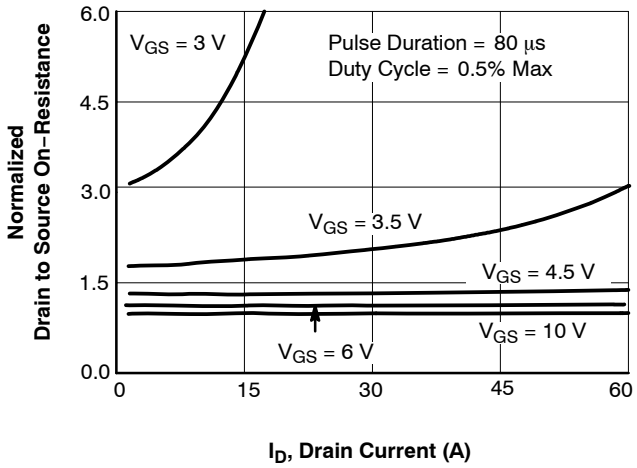


**Figure 2. Normalized On−Resistance vs. Drain Current and Gate Voltage**

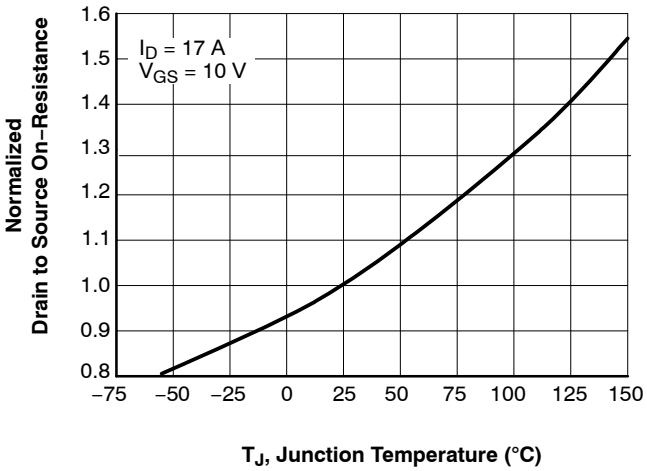


**Figure 3. Normalized On−Resistance vs. Junction Temperature**

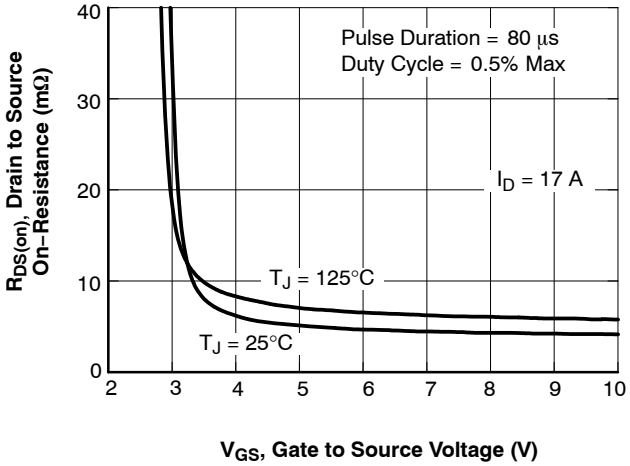


**Figure 4. On−Resistance vs. Gate to Source Voltage**

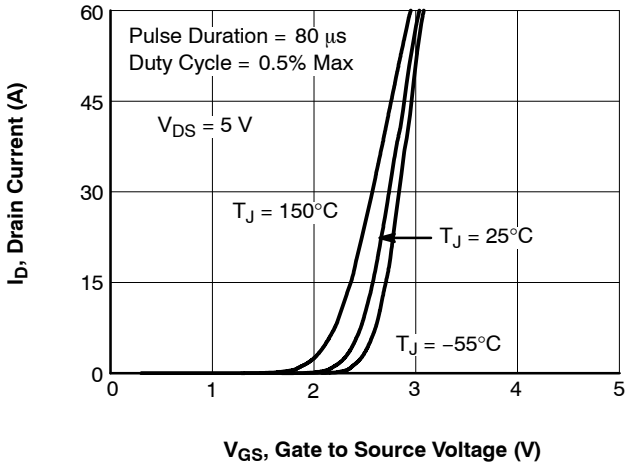


**Figure 5. Transfer Characteristics**

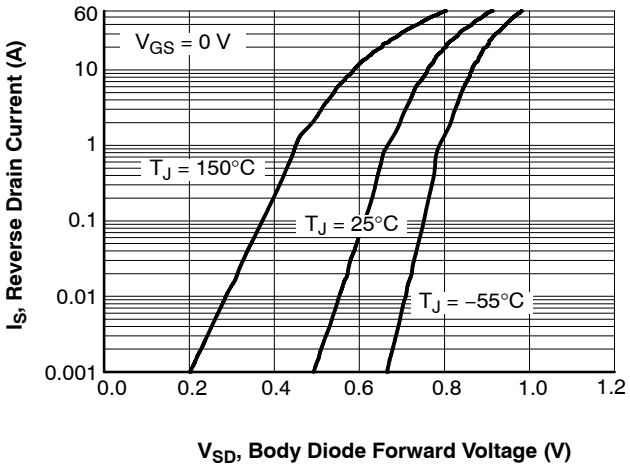


**Figure 6. Source to Drain Diode Forward Voltage vs. Source Current**



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## TYPICAL CHARACTERISTICS (Q1 N-CHANNEL)

($T_J$ = 25°C unless otherwise noted) (continued)

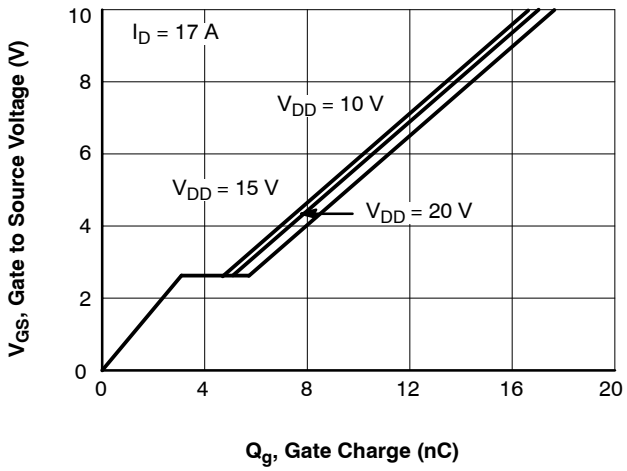


**Figure 7. Gate Charge Characteristics**

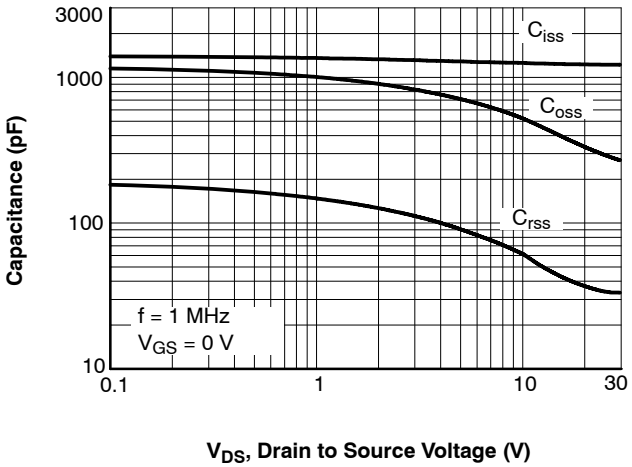


**Figure 8. Capacitance vs. Drain to Source Voltage**

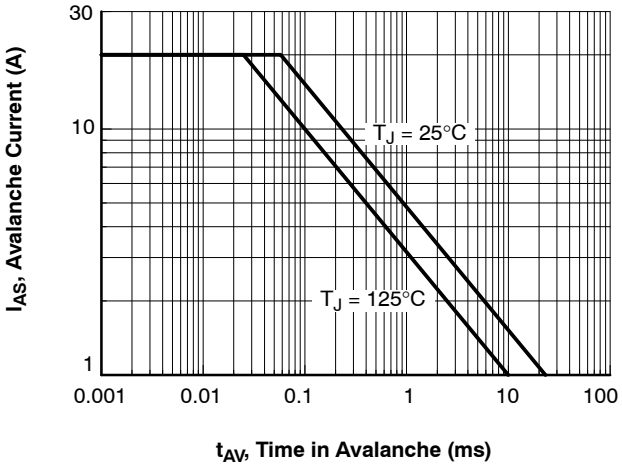


**Figure 9. Unclamped Inductive Switching Capability**

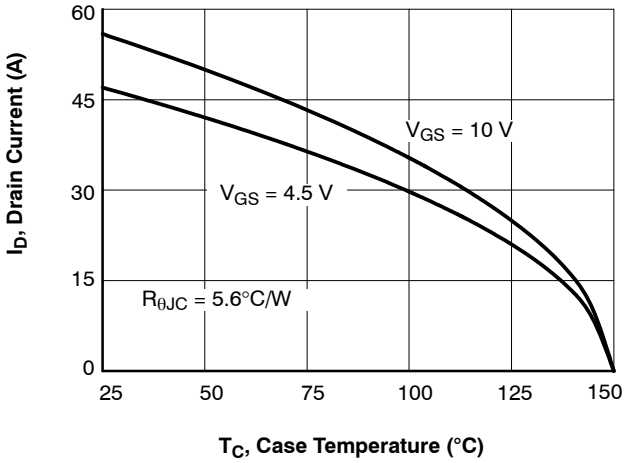


**Figure 10. Maximum Continuous Drain Current vs. Case Temperature**

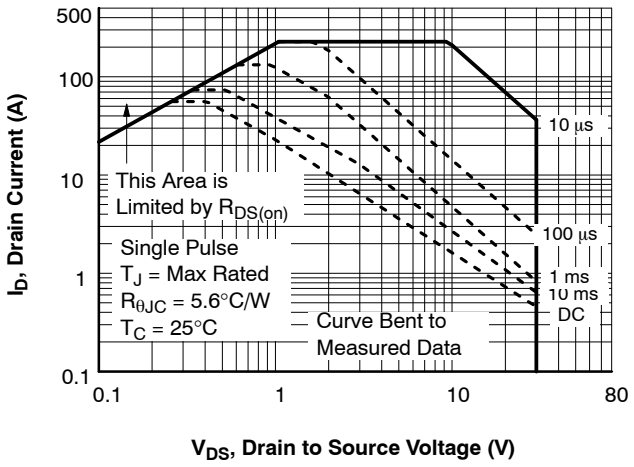


**Figure 11. Forward Bias Safe Operating Area**

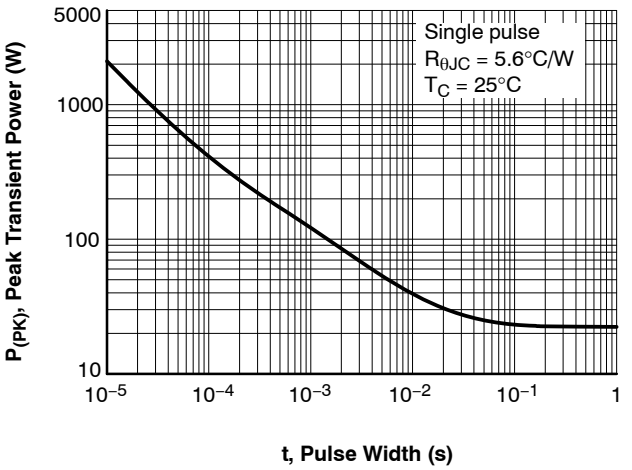


**Figure 12. Single Pulse Maximum Power Dissipation**



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## TYPICAL CHARACTERISTICS (Q1 N-CHANNEL)

($T_J$ = 25°C unless otherwise noted) (continued)

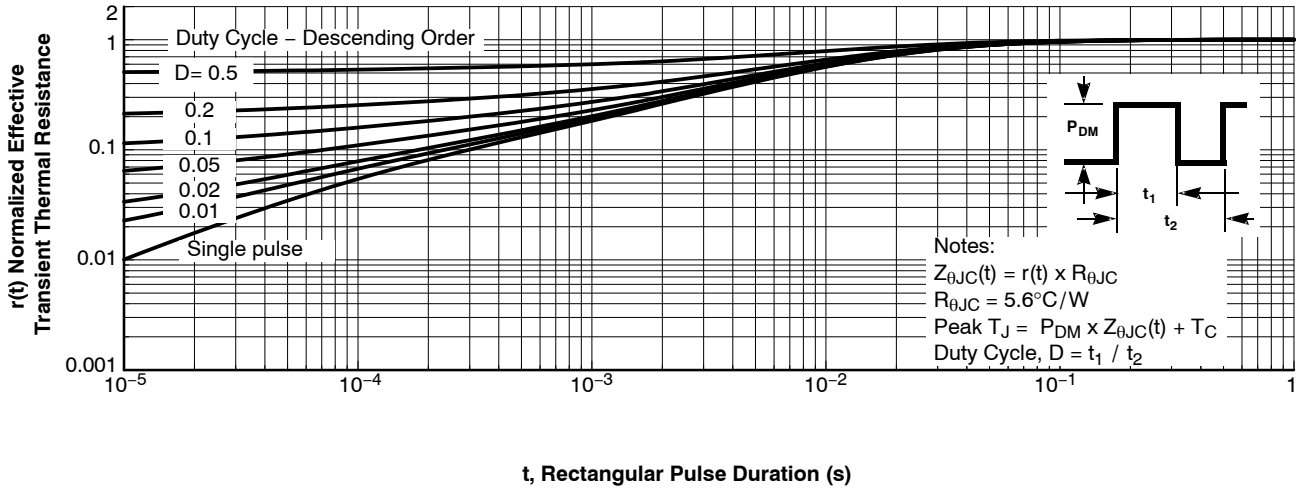


**Figure 13. Junction−to−Case Transient Thermal Response Curve**



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## TYPICAL CHARACTERISTICS (Q2 N-CHANNEL)

($T_J$ = 25°C unless otherwise noted)

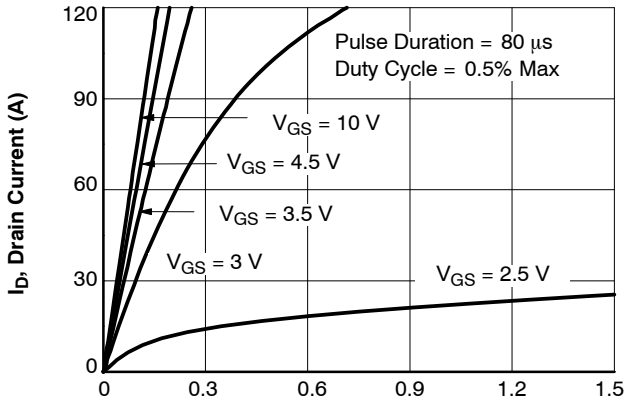


Figure 14. On−Region Characteristics

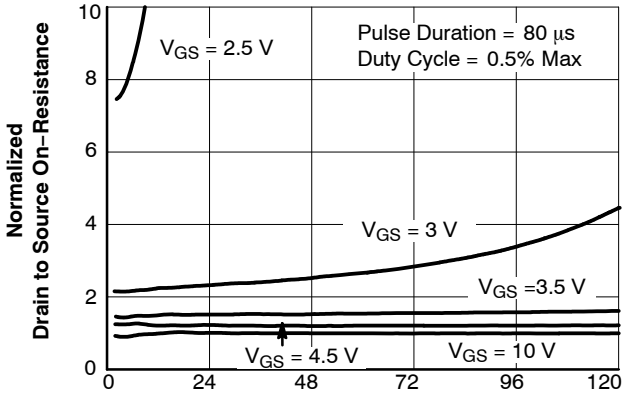


Figure 15. Normalized On−Resistance vs. Drain Current and Gate Voltage

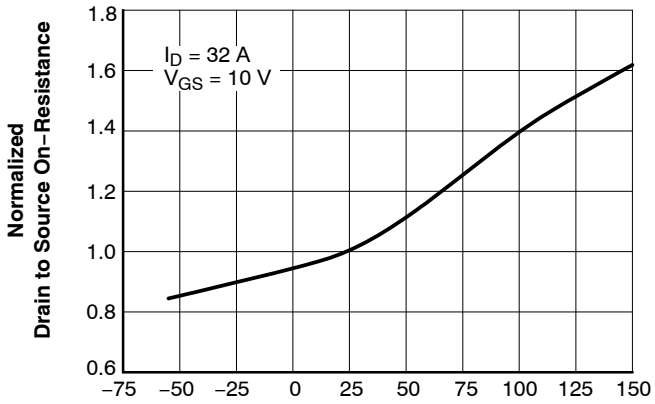


Figure 16. Normalized On−Resistance vs. Junction Temperature

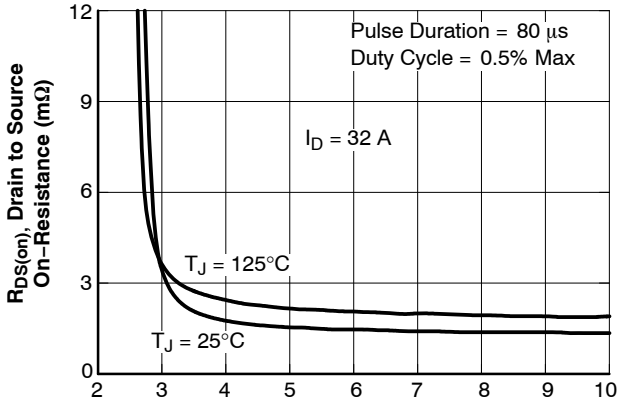


Figure 17. On−Resistance vs. Gate to Source Voltage

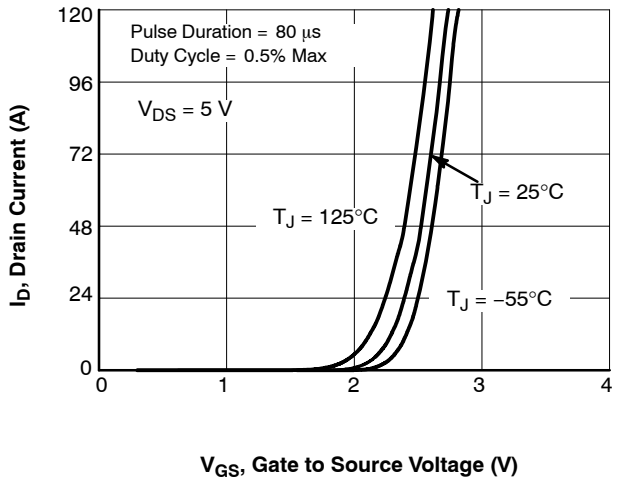


Figure 18. Transfer Characteristics

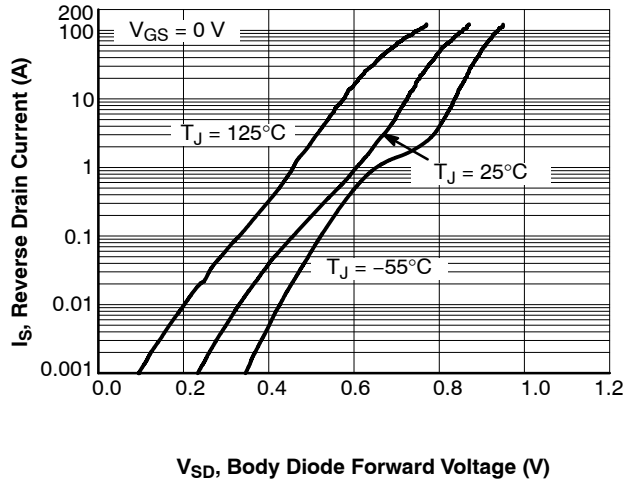


Figure 19. Source to Drain Diode Forward Voltage vs. Source Current



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## TYPICAL CHARACTERISTICS (Q2 N-CHANNEL)

($T_J$ = 25°C unless otherwise noted) (continued)

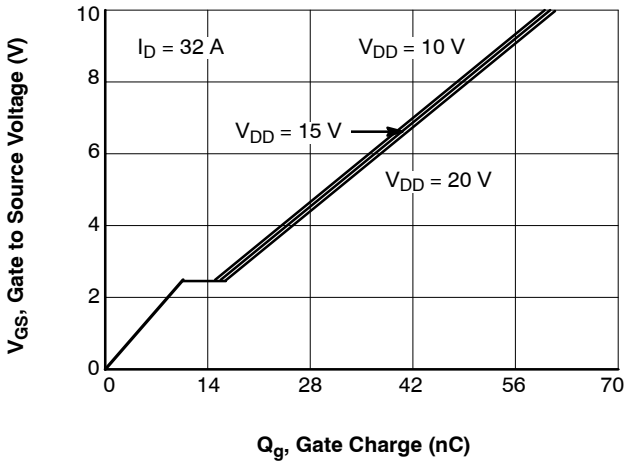


**Figure 20. Gate Charge Characteristics**

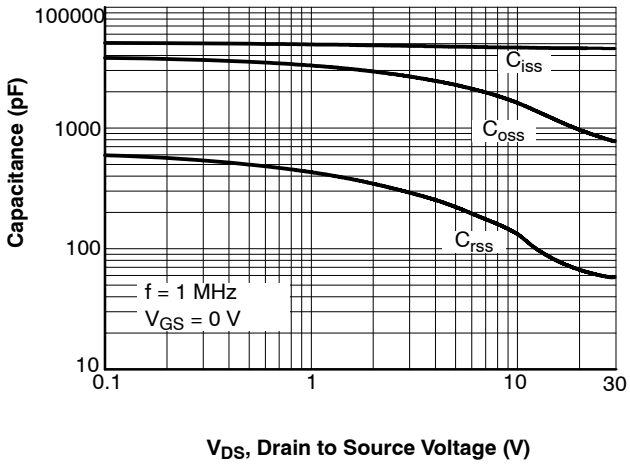


**Figure 21. Capacitance vs. Drain to Source Voltage**

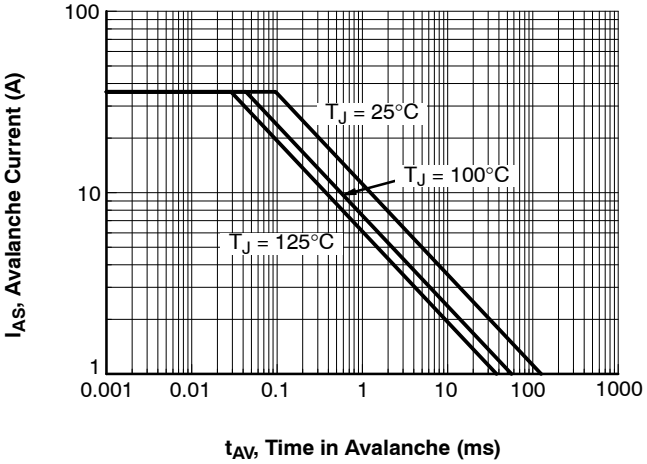


**Figure 22. Unclamped Inductive Switching Capability**

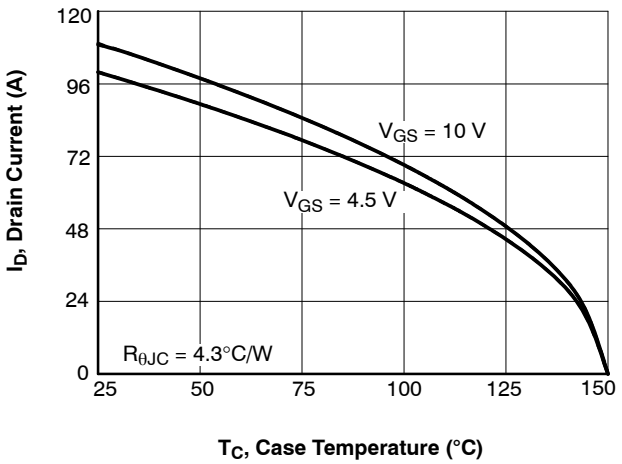


**Figure 23. Maximum Continuous Drain Current vs. Case Temperature**

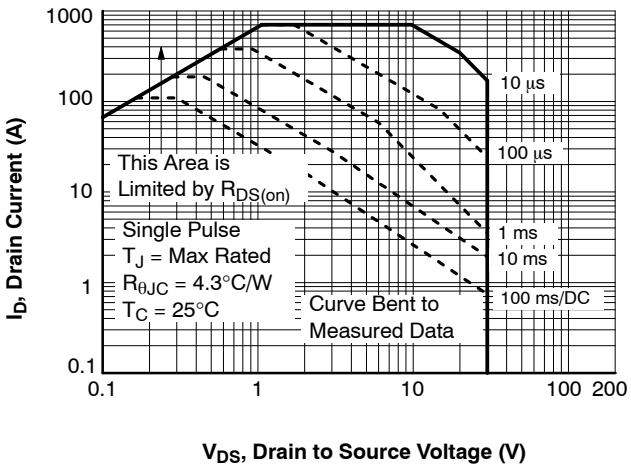


**Figure 24. Forward Bias Safe Operating Area**

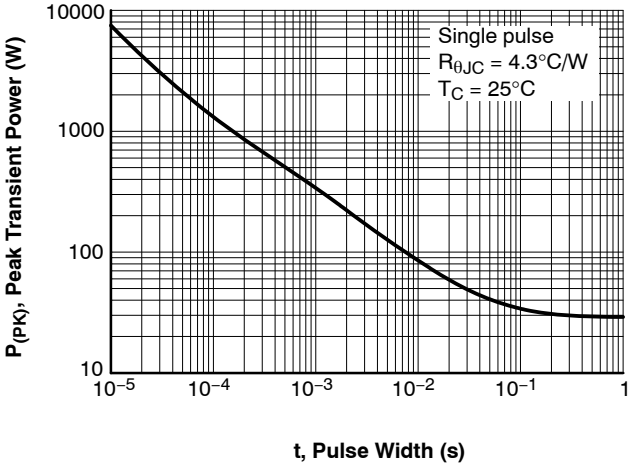


**Figure 25. Single Pulse Maximum Power Dissipation**



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## TYPICAL CHARACTERISTICS (Q2 N-CHANNEL)

($T_J$ = 25°C unless otherwise noted) (continued)

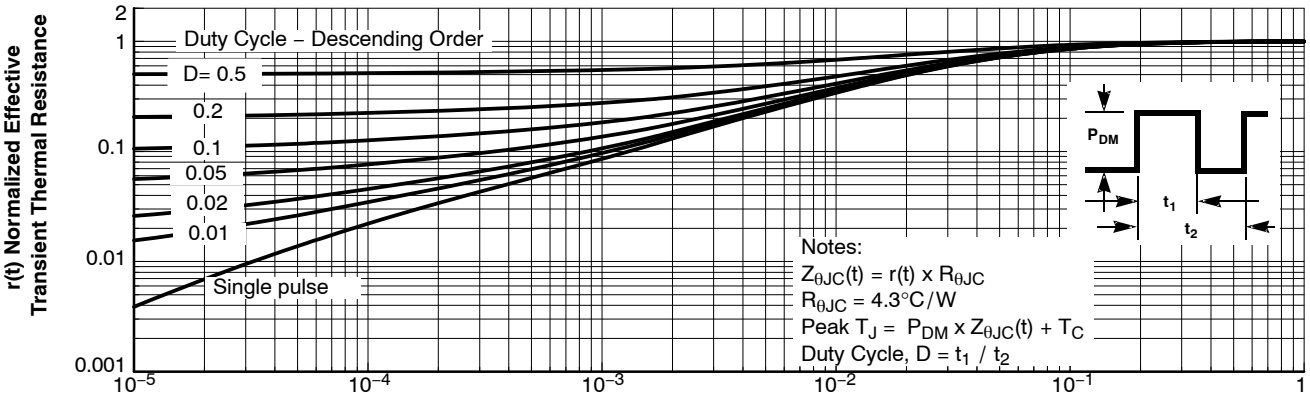


**Figure 26. Junction−to−Case Transient Thermal Response Curve**



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## 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 27 shows the reverse recovery characteristic of the FDPC5018SG.

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

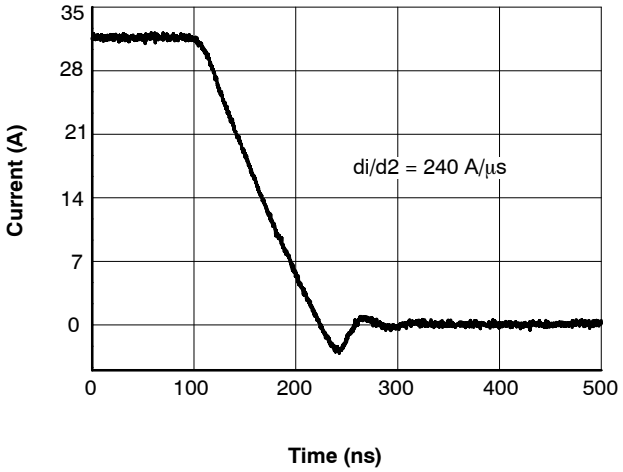


**Figure 27. SyncFET Body Diode Reverse Recovery Characteristic**

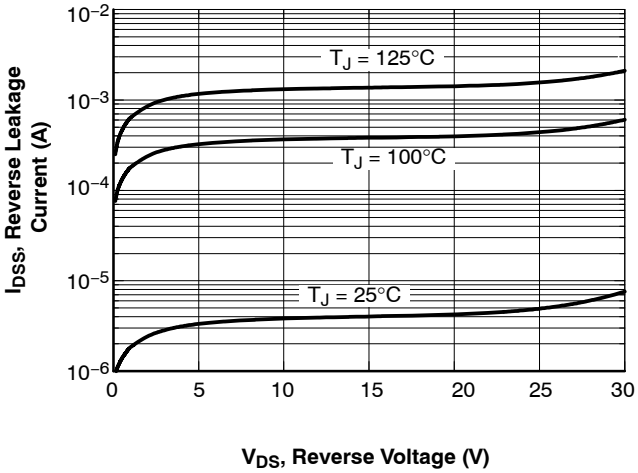


**Figure 28. SyncFET Body Diode Reverse Leakage vs. Drain−Source Voltage**

### PACKAGE MARKING AND ORDERING INFORMATION

| Device | Top Marking | Package | Reel Size | Tape Width | Shipping† |
|---|---|---|---|---|---|
| FDPC5018SG | FDPC5018SG | Power Clip 56 | 13″ | 12 mm | 3,000 / 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.

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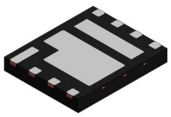

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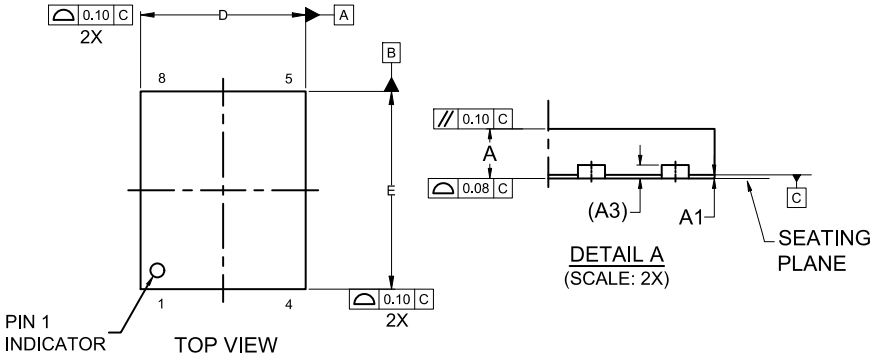


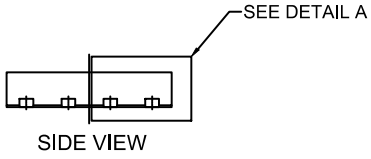


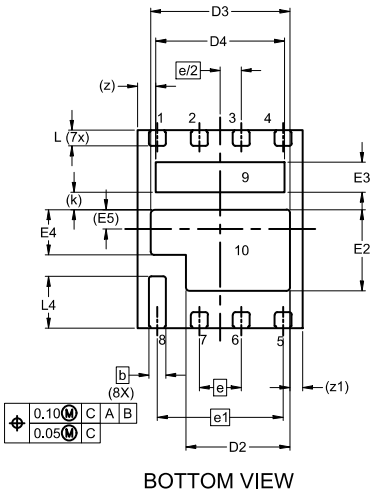


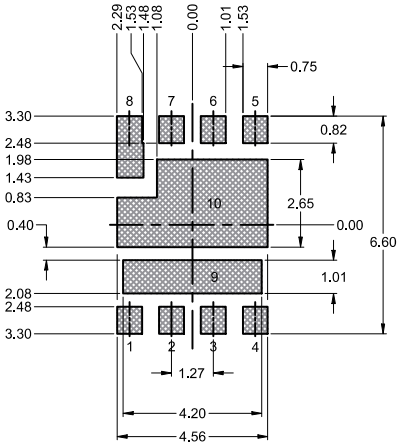


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NOTES: UNLESS OTHERWISE SPECIFIED

A) DOES NOT FULLY CONFORM TO JEDEC REGISTRATION, MO-229, DATED 11/2001.
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.

| DIM | MILLIMETERS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | 0.70 | 0.75 | 0.80 |
| A1 | 0.00 | - | 0.05 |
| A3 | 0.20 REF | | |
| b | 0.51 BSC | | |
| D | 4.90 | 5.00 | 5.10 |
| D2 | 3.05 | 3.15 | 3.25 |
| D3 | 4.12 | 4.22 | 4.32 |
| D4 | 3.80 | 3.90 | 4.00 |
| E | 5.90 | 6.00 | 6.10 |
| E2 | 2.36 | 2.46 | 2.56 |
| E3 | 0.81 | 0.91 | 1.01 |
| E4 | 1.27 | 1.37 | 1.47 |
| E5 | 0.59 REF | | |
| e | 1.27 BSC | | |
| e/2 | 0.635 BSC | | |
| e1 | 3.81 BSC | | |
| k | 0.52 REF | | |
| L | 0.38 | 0.48 | 0.58 |
| L4 | 1.47 | 1.57 | 1.67 |
| z | 0.55 REF | | |
| z1 | 0.39 REF | | |

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