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October 2016

# FDPC3D5N025X9D

## PowerTrench® Power Clip
## 25V Symmetric Dual N-Channel MOSFET

### Features

Q1: N-Channel

- Max $r_{DS(on)}$ = 3.01 mΩ at $V_{GS}$ = 10 V, $I_D$ = 18 A
- Max $r_{DS(on)}$ = 3.67 mΩ at $V_{GS}$ = 4.5 V, $I_D$ = 16 A

Q2: N-Channel

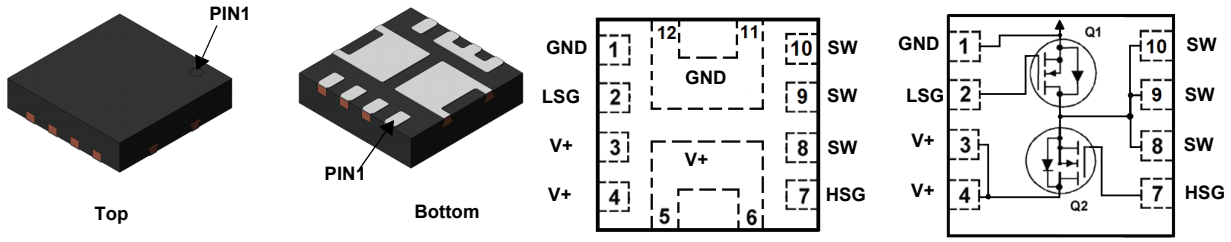
- Max $r_{DS(on)}$ = 3.01 mΩ at $V_{GS}$ = 10 V, $I_D$ = 18 A
- Max $r_{DS(on)}$ = 3.67 mΩ at $V_{GS}$ = 4.5 V, $I_D$ = 16 A
- Low Inductance Packaging Shortens Rise/Fall Times, Resulting in Lower Switching Losses
- MOSFET Integration Enables Optimum Layout for Lower Circuit Inductance and Reduced Switch Node Ringing
- RoHS Compliant

### 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 (Q2) and synchronous (Q1) have been designed to provide optimal power efficiency.

### Applications

- Computing
- Communications
- General Purpose Point of Load




Power Clip 33 Symmetric

| Pin | Name | Description | Pin | Name | Description | Pin | Name | Description |
|---|---|---|---|---|---|---|---|---|
| 1,11,12 | GND(LSS) | Low Side Source | 3,4,5,6 | V+(HSD) | High Side Drain | 8,9,10 | SW | Switching Node, Low Side Drain |
| 2 | LSG | Low Side Gate | 7 | HSG | High Side Gate | | | |

## MOSFET Maximum Ratings $T_A$ = 25 °C unless otherwise noted.

| Symbol | Parameter | | | | Q1 | Q2 | Units |
|---|---|---|---|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | | | | 25 | 25 | V |
| $V_{GS}$ | Gate to Source Voltage | | | | ±12 | ±12 | V |
| $I_D$ | Drain Current | -Continuous | $T_C$ = 25 °C | (Note5) | 74 | 74 | A |
| | | -Continuous | $T_C$ = 100 °C | (Note5) | 47 | 47 | |
| | | -Continuous | $T_A$ = 25 °C | | 18[Note1a] | 18[Note1b] | |
| | | -Pulsed | $T_A$ = 25 °C | (Note 4) | 349 | 349 | |
| $E_{AS}$ | Single Pulse Avalanche Energy | | | (Note 3) | 96 | 96 | mJ |
| $P_D$ | Power Dissipation for Single Operation | | $T_C$ = 25 °C | | 26 | 26 | W |
| | Power Dissipation for Single Operation | | $T_A$ = 25 °C | | 1.8[Note1a] | 1.8[Note1b] | |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | | | | -55 to +150 | | °C |

### Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | 4.8 | 4.8 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 70[Note1a] | 70[Note1b] | |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 135[Note1c] | 135[Note1d] | |

## Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FDPCN025X9D | FDPC3D5N025X9D | Power Clip 33 Symm | 13 ” | 12 mm | 3000 units |

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

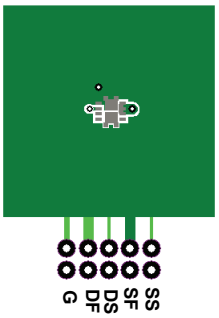
| Symbol | Parameter | Test Conditions | Type | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = 250 μA, $V_{GS}$ = 0 V<br>$I_D$ = 250 μA, $V_{GS}$ = 0 V | Q1<br>Q2 | 25<br>25 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, referenced to 25 °C<br>$I_D$ = 250 μA, referenced to 25 °C | Q1<br>Q2 | | 23<br>23 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 20 V, $V_{GS}$ = 0 V<br>$V_{DS}$ = 20 V, $V_{GS}$ = 0 V | Q1<br>Q2 | | | 1<br>1 | μA<br>μA |
| $I_{GSS}$ | Gate to Source Leakage Current, Forward | $V_{GS}$ = 12 V/-8 V, $V_{DS}$= 0 V<br>$V_{GS}$ = 12 V/-8 V, $V_{DS}$= 0 V | Q1<br>Q2 | | | ±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>$V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | Q1<br>Q2 | 1.0<br>1.0 | 1.5<br>1.5 | 3.0<br>3.0 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D$ = 250 μA, referenced to 25 °C<br>$I_D$ = 250 μA, referenced to 25 °C | Q1<br>Q2 | | -4<br>-4 | | mV/°C |
| $r_{DS(on)}$ | Drain to Source On Resistance | $V_{GS}$ = 10V, $I_D$ = 18 A<br>$V_{GS}$ = 4.5 V, $I_D$ = 16 A<br>$V_{GS}$ = 10 V, $I_D$ = 18 A,$T_J$ =125 °C | Q1 | | 2.0<br>2.4<br>2.87 | 3.01<br>3.67<br>4.32 | mΩ |
| | | $V_{GS}$ = 10V, $I_D$ = 18 A<br>$V_{GS}$ = 4.5 V, $I_D$ = 16 A<br>$V_{GS}$ = 10 V, $I_D$ = 18 A ,$T_J$ =125 °C | Q2 | | 2.5<br>2.9<br>3.6 | 3.01<br>3.67<br>4.33 | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 5 V, $I_D$ = 18 A<br>$V_{DS}$ = 5 V, $I_D$ = 18 A | Q1<br>Q2 | | 133<br>124 | | S |
| **Dynamic Characteristics** | | | | | | | |
| $C_{iss}$ | Input Capacitance | Q1:<br>$V_{DS}$ = 13 V, $V_{GS}$ = 0 V, f = 1 MHZ<br>Q2:<br>$V_{DS}$ = 13 V, $V_{GS}$ = 0 V, f = 1 MHZ | Q1<br>Q2 | | 2385<br>2385 | 3340<br>3340 | pF |
| $C_{oss}$ | Output Capacitance | | Q1<br>Q2 | | 612<br>612 | 860<br>860 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | Q1<br>Q2 | | 78<br>78 | 130<br>130 | pF |
| $R_g$ | Gate Resistance | | Q1<br>Q2 | 0.1<br>0.1 | 0.6<br>0.6 | 1.8<br>1.8 | Ω |
| **Switching Characteristics** | | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | Q1:<br>$V_{DD}$ = 13V, $I_D$ = 18 A, $R_{GEN}$ = 6 Ω<br>Q2:<br>$V_{DD}$ = 13 V, $I_D$ = 18 A, $R_{GEN}$ = 6 Ω | Q1<br>Q2 | | 10<br>10 | 20<br>20 | ns |
| $t_r$ | Rise Time | | Q1<br>Q2 | | 3<br>3 | 10<br>10 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | Q1<br>Q2 | | 29<br>29 | 46<br>46 | ns |
| $t_f$ | Fall Time | | Q1<br>Q2 | | 3<br>3 | 10<br>10 | ns |
| $Q_g$ | Total Gate Charge | $V_{GS}$ = 0 V to 10 V<br>Q1<br>$V_{DD}$ = 13 V, $I_D$ = 18 A<br>Q2<br>$V_{DD}$ = 13 V, $I_D$ = 18 A | Q1<br>Q2 | | 36<br>36 | 51<br>51 | nC |
| $Q_g$ | Total Gate Charge | $V_{GS}$ = 0 V to 4.5 V | Q1<br>Q2 | | 17<br>17 | 24<br>24 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | Q1<br>Q2 | | 5.3<br>5.3 | | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | Q1<br>Q2 | | 3.9<br>3.9 | | nC |

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

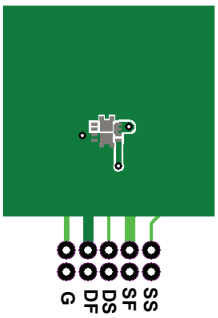
| Symbol | Parameter | Test Conditions | Type | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| **Drain-Source Diode Characteristics** | | | | | | | |
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 18 A (Note 2)<br>$V_{GS}$ = 0 V, $I_S$ = 18 A (Note 2) | Q1<br>Q2 | | 0.8<br>0.8 | 1.2<br>1.2 | V |
| $I_S$ | Diode continuous forward current | $T_C$ = 25 °C | Q1<br>Q2 | | 74<br>74 | | A |
| $I_{S,Pulse}$ | Diode pulse current | | Q1<br>Q2 | | 349<br>349 | | A |
| $t_{rr}$ | Reverse Recovery Time | Q1<br>$I_F$ = 18 A, di/dt = 100 A/µs | Q1<br>Q2 | | 35<br>35 | 56<br>56 | ns |
| $Q_{rr}$ | Reverse Recovery Charge | Q2<br>$I_F$ = 18 A, di/dt = 100 A/µs | Q1<br>Q2 | | 19<br>19 | 35<br>35 | nC |

Notes:

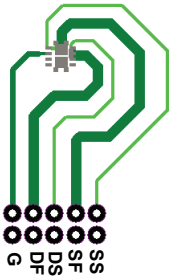
1.$R_{\theta JA}$ is determined with the device mounted on a 1 $in^2$ pad 2 oz copper pad on a 1.5 x 1.5 in. board of FR-4 material. $R_{\theta CA}$ is determined by the user's board design.



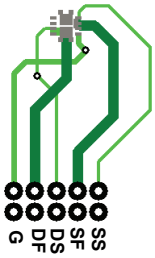

a. 70 °C/W when mounted on a 1 $in^2$ pad of 2 oz copper




b. 70 °C/W when mounted on a 1 $in^2$ pad of 2 oz copper




c. 135 °C/W when mounted on a minimum pad of 2 oz copper




d. 135 °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 96 mJ is based on starting $T_J$ = 25 °C; N-ch: L = 3 mH, $I_{AS}$ = 8 A, $V_{DD}$ = 25 V, $V_{GS}$ = 10 V. 100% test at L= 0.1 mH, $I_{AS}$ = 26 A.
Q2: $E_{AS}$ of 96 mJ is based on starting $T_J$ = 25 °C; N-ch: L = 3 mH, $I_{AS}$ = 8 A, $V_{DD}$ = 25 V, $V_{GS}$ = 10 V. 100% test at L= 0.1 mH, $I_{AS}$ = 26 A.

4. Pulse Id refers to Figure.11 & Figure. 26 Forward Bias Safe Operation Area.

5. Computed continuous current limited to Max Junction Temperature only, actual continuous current will be limited by thermal & electro-mechanical application board design.

## Typical Characteristics (Q1 N-Channel) $T_J$ = 25°C unless otherwise noted.

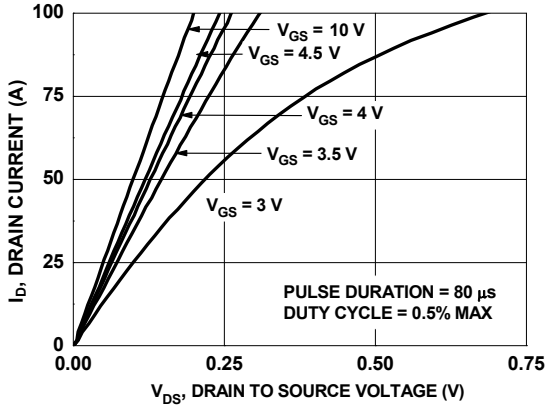



**Figure 1. On Region Characteristics**

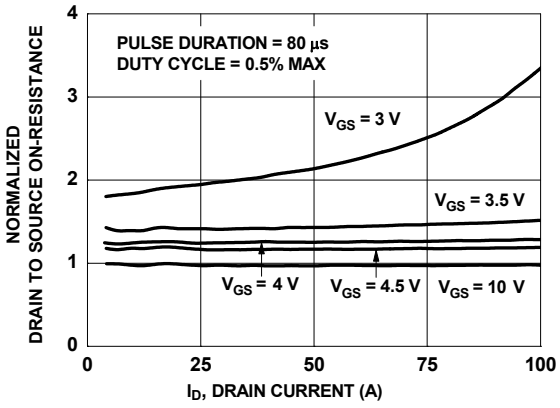



**Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage**

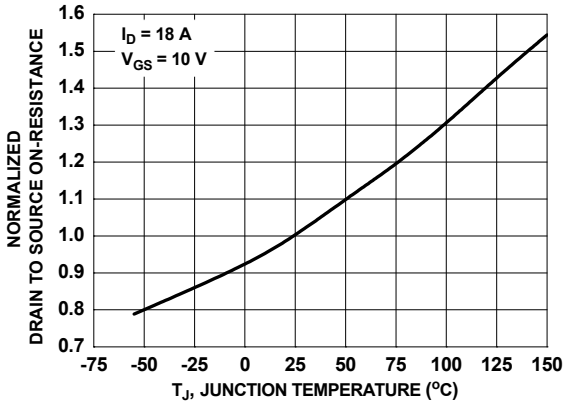



**Figure 3. Normalized On Resistance vs. Junction Temperature**

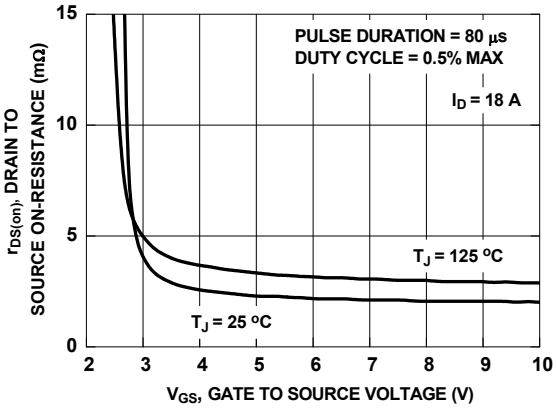



**Figure 4. On-Resistance vs. Gate to Source Voltage**

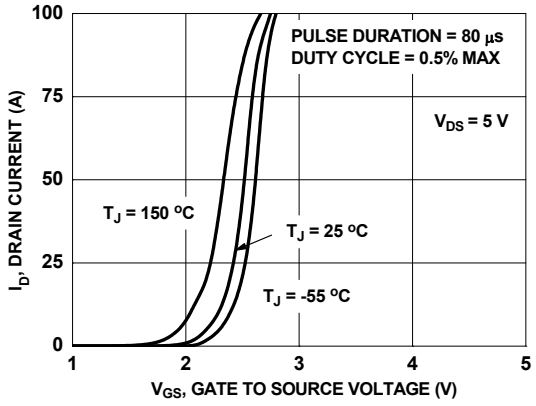



**Figure 5. Transfer Characteristics**

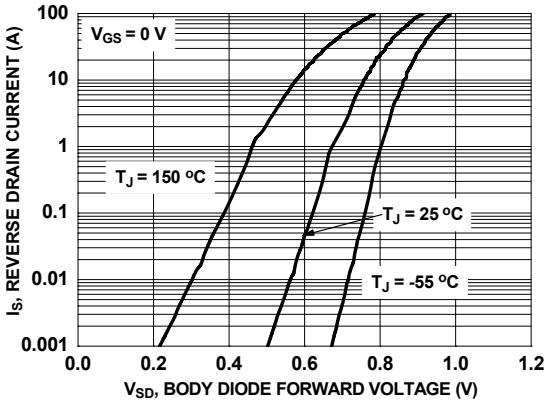



**Figure 6. Source to Drain Diode Forward Voltage vs. Source Current**

## Typical Characteristics (Q1 N-Channel) $T_J$ = 25°C unless otherwise noted.

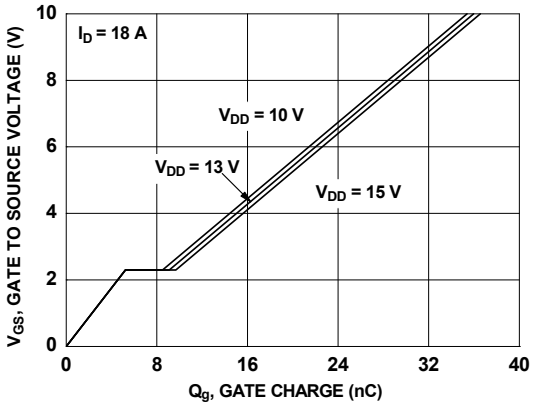



**Figure 7. Gate Charge Characteristics**

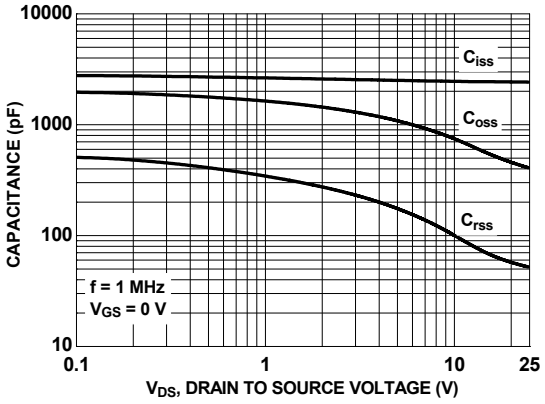



**Figure 8. Capacitance vs. Drain to Source Voltage**

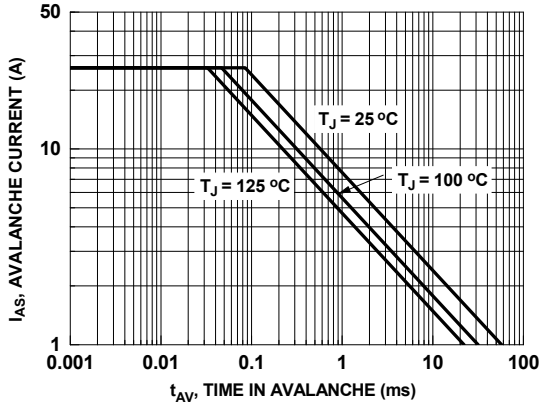



**Figure 9. Unclamped Inductive Switching Capability**

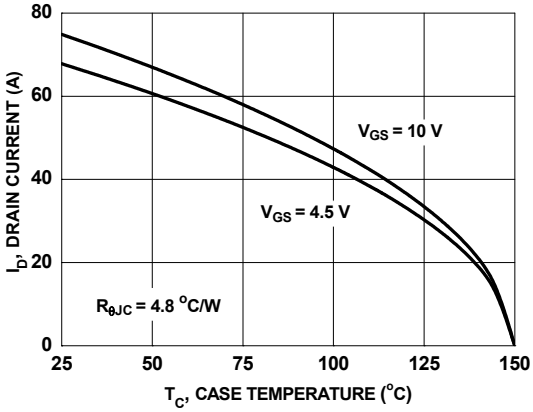



**Figure 10. Maximum Continuous Drain Current vs. Case Temperature**

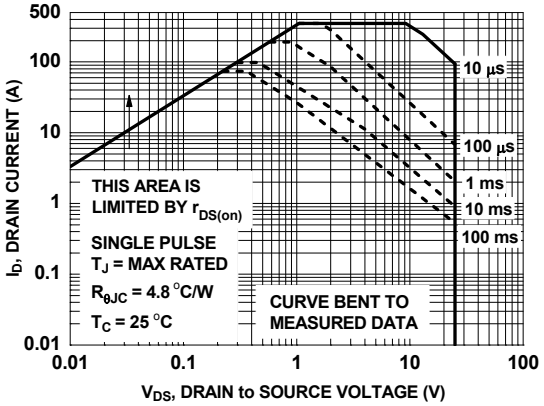



**Figure 11. Forward Bias Safe Operating Area**

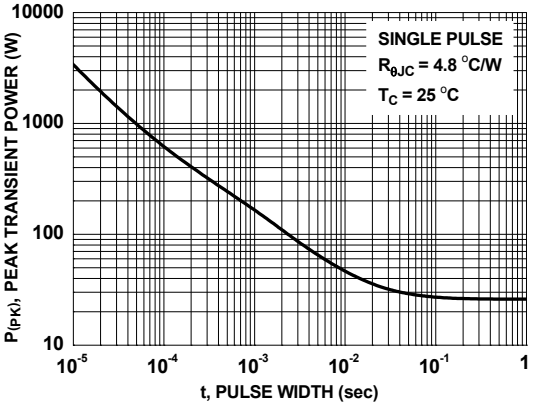



**Figure 12. Single Pulse Maximum Power Dissipation**

## Typical Characteristics (Q1 N-Channel) $T_J$ = 25°C unless otherwise noted.

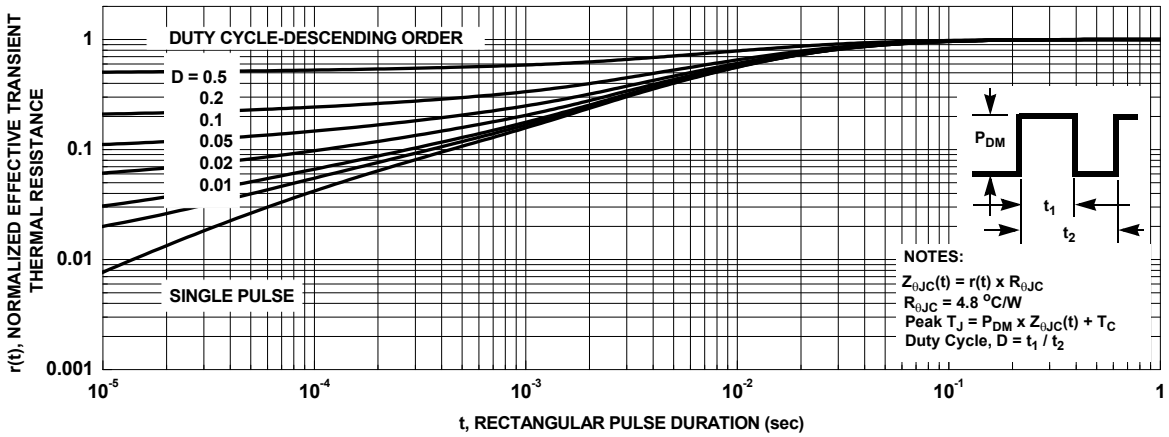



**Figure 13. Junction-to-Case Transient Thermal Response Curve**

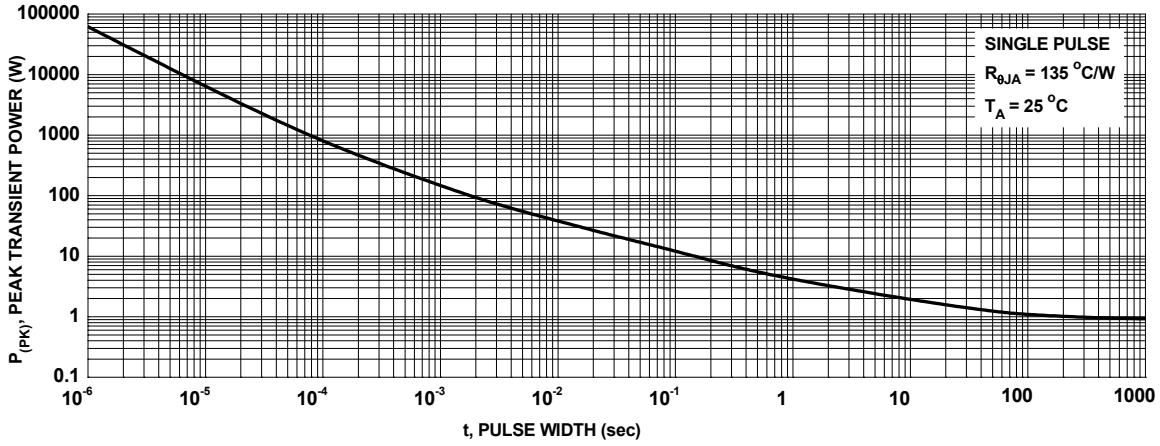



**Figure 14. Single Pulse Maximum Power Dissipation**

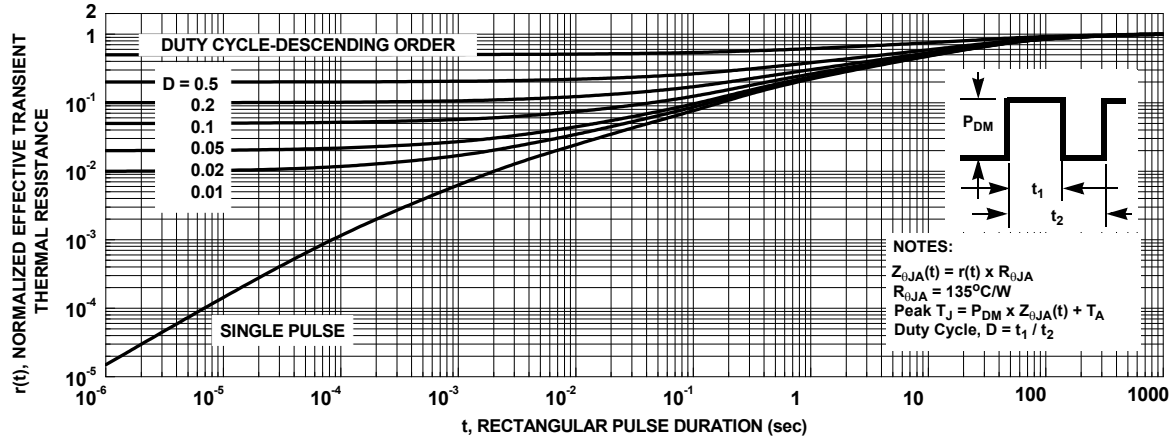



**Figure 15. Junction-to-Ambient Transient Thermal Response Curve**

## Typical Characteristics (Q2 N-Channel) $T_J$ = 25 °C unless otherwise noted.

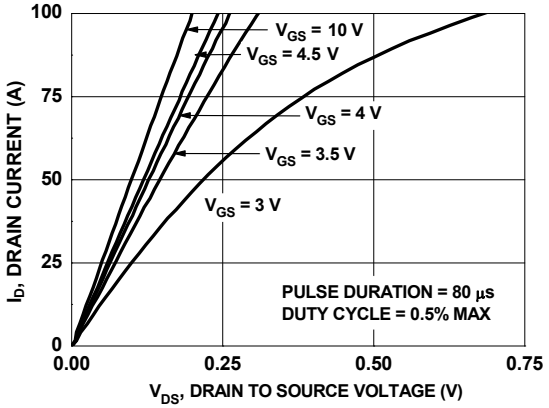



**Figure 16. On- Region Characteristics**

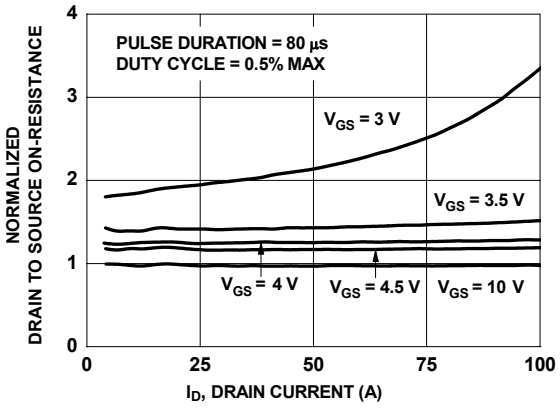



**Figure 17. Normalized on-Resistance vs. Drain Current and Gate Voltage**

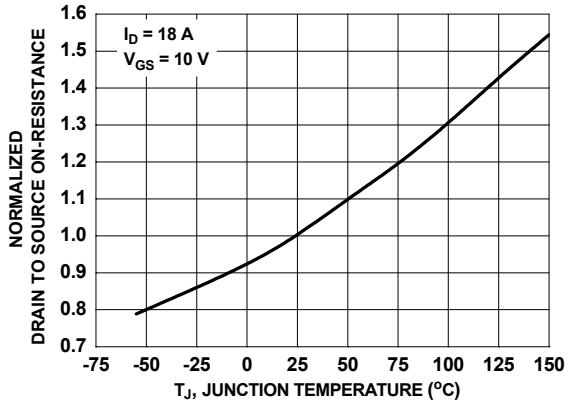



**Figure 18. Normalized On-Resistance vs. Junction Temperature**

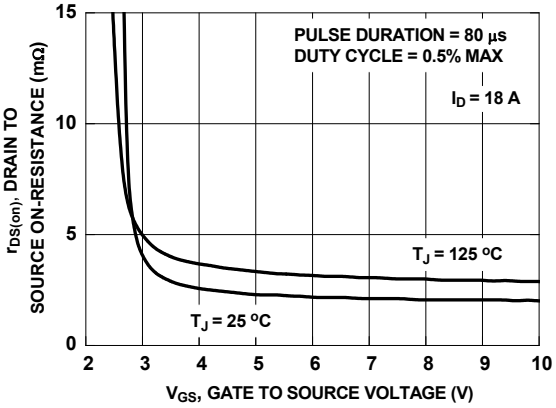



**Figure 19. On-Resistance vs. Gate to Source Voltage**

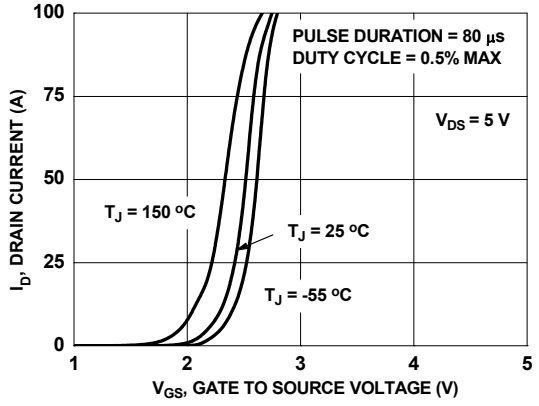



**Figure 20. Transfer Characteristics**

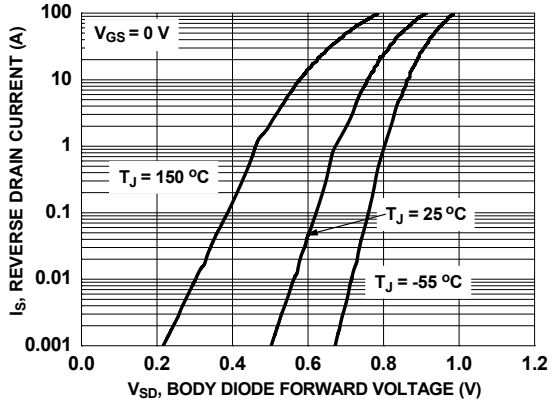



**Figure 21. Source to Drain Diode Forward Voltage vs. Source Current**

## Typical Characteristics (Q2 N-Channel) $T_J$ = 25°C unless otherwise noted.

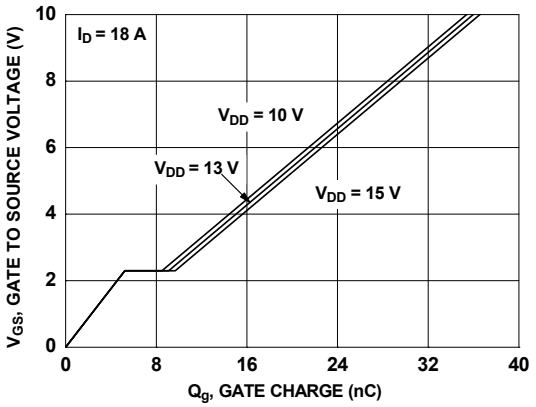



**Figure 22. Gate Charge Characteristics**

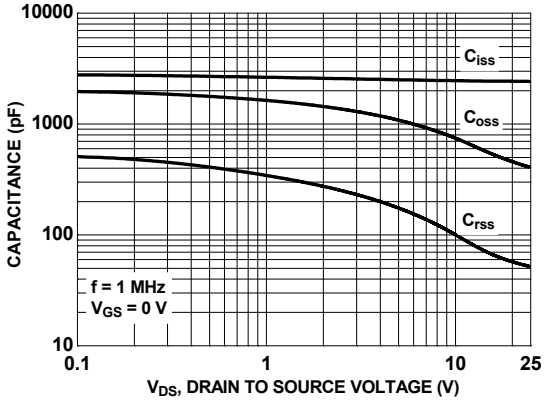



**Figure 23. Capacitance vs. Drain to Source Voltage**

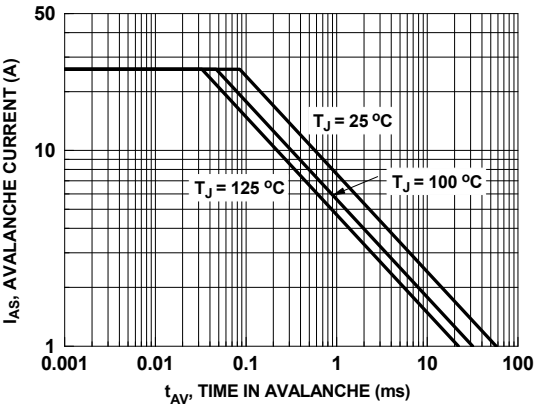



**Figure 24. Unclamped Inductive Switching Capability**

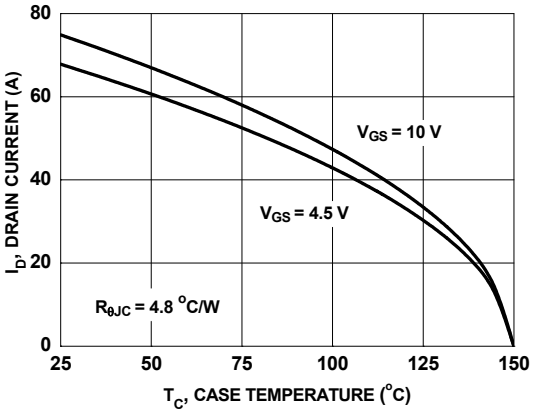



**Figure 25. Maximum Continuous Drain Current vs. Case Temperature**

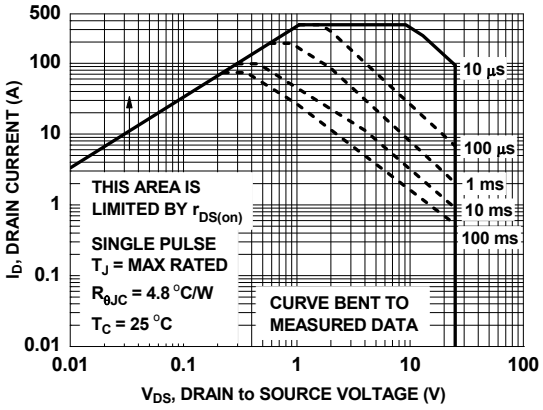



**Figure 26. Forward Bias Safe Operating Area**

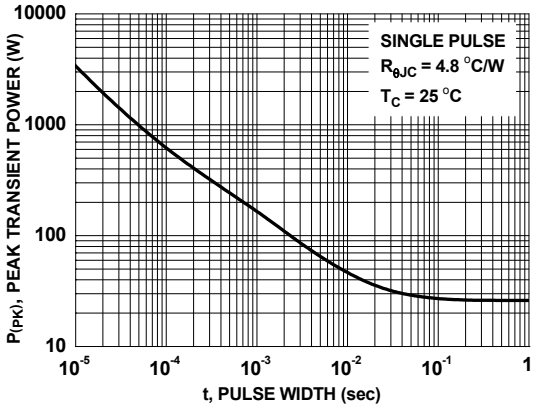



**Figure 27. Single Pulse Maximum Power Dissipation**

## Typical Characteristics (Q2 N-Channel) $T_J$ = 25 °C unless otherwise noted.

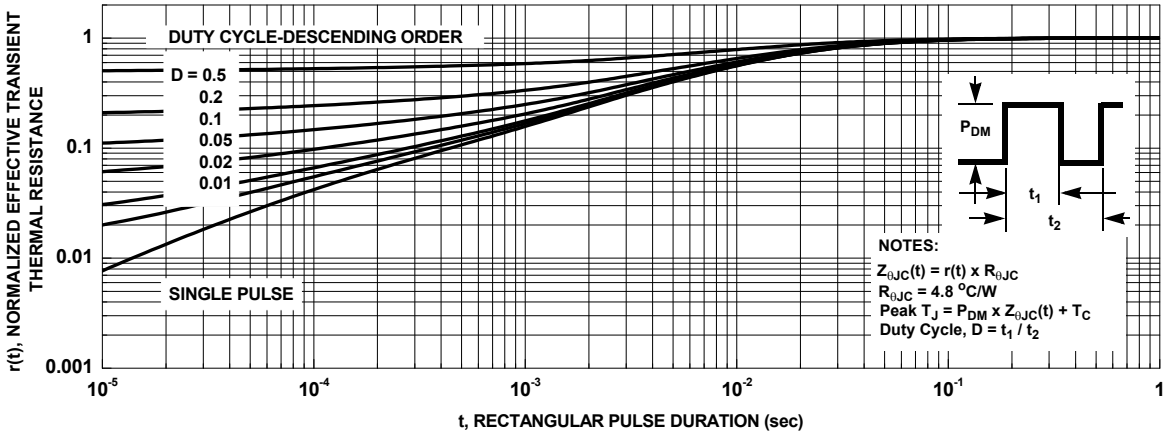



**Figure 28. Junction-to-Case Transient Thermal Response Curve**

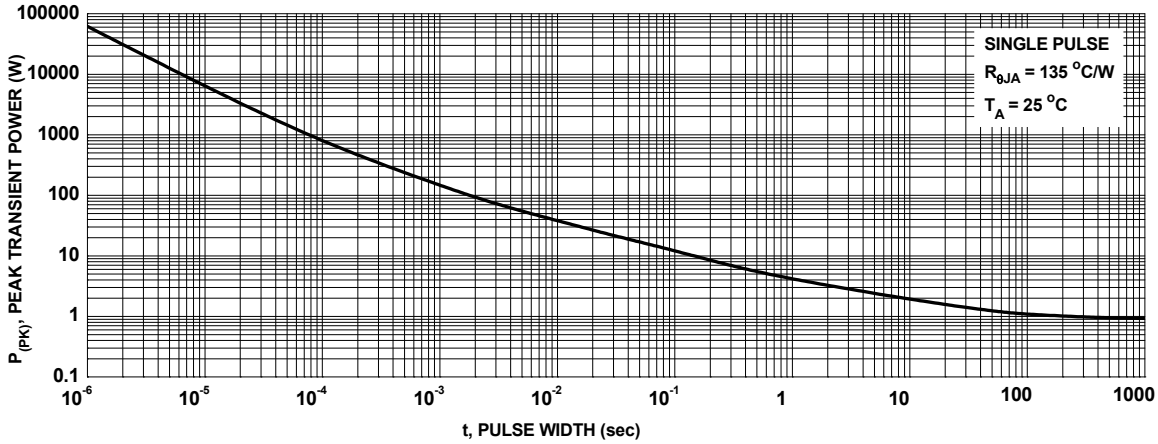



**Figure 29. Single Pulse Maximum Power Dissipation**

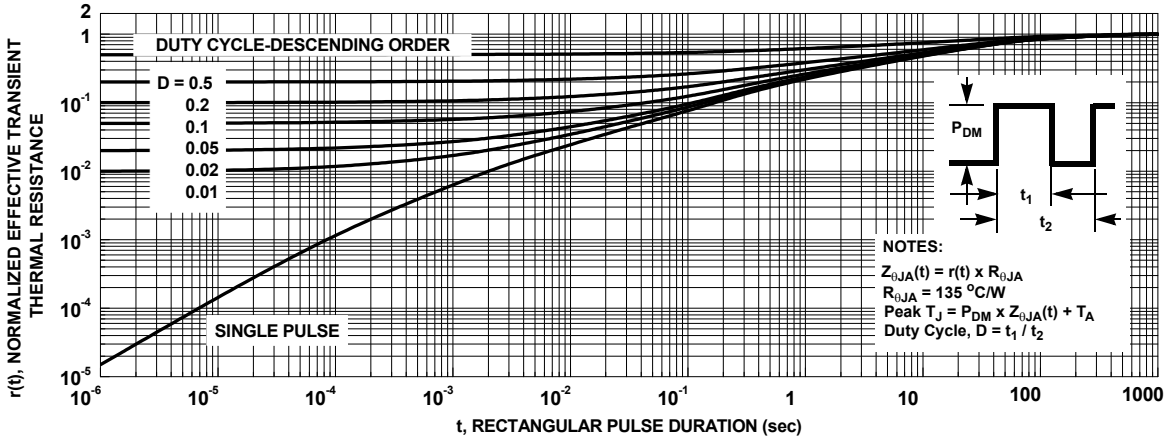
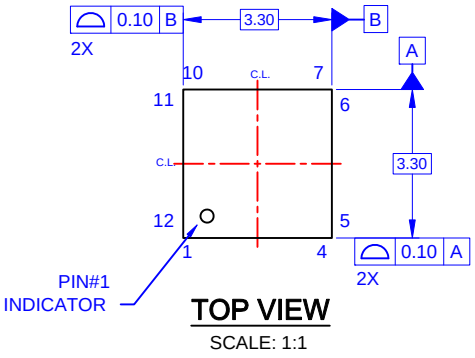
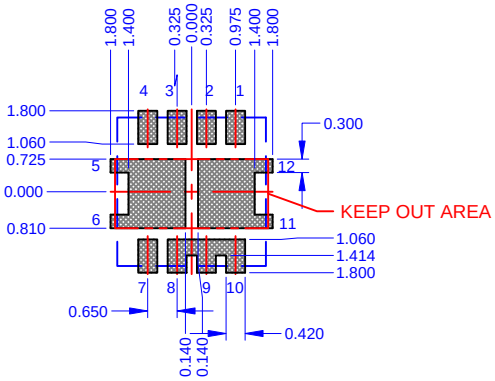



**Figure 30. Junction-to-Ambient Transient Thermal Response Curve**



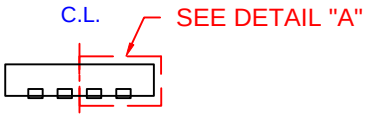

TOP VIEW

SCALE: 1:1



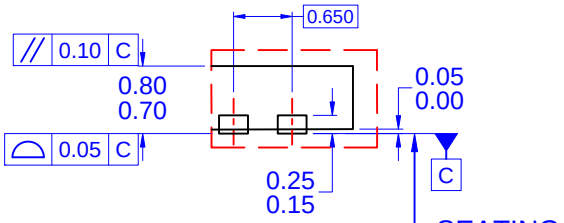

LAND PATTERN RECOMMENDATION

SCALE 1:1



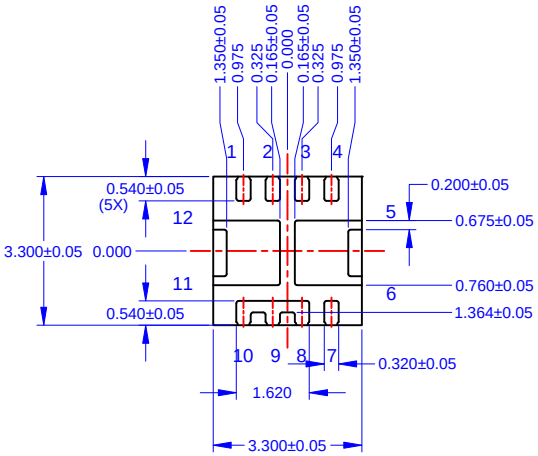

FRONT VIEW

SCALE: 1:1




DETAIL 'A'

SCALE: 2:1




BOTTOM VIEW

SCALE: 1:1

NOTES: UNLESS OTHERWISE SPECIFIED

A) DRAWING DOES NOT FULLY CONFORM TO JEDEC REGISTRATION MO-220, VARIATION WEEC-1
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) DRAWING FILE NAME: MKT-PQFN12A_REV1

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105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:
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