FAIRCHILD SEMICONDUCTOR®

March 2007

# FDS8858CZ

## Dual N & P-Channel PowerTrench® MOSFET

### N-Channel: 30V, 8.6A, 17.0mΩ P-Channel: -30V, -7.3A, 20.5mΩ

### Features

Q1: N-Channel

- Max $r_{DS(on)}$ = 17mΩ at $V_{GS}$ = 10V, $I_D$ = 8.6A
- Max $r_{DS(on)}$ = 20mΩ at $V_{GS}$ = 4.5V, $I_D$ = 7.3A

Q2: P-Channel

- Max $r_{DS(on)}$ = 20.5mΩ at $V_{GS}$ = -10V, $I_D$ = -7.3A
- Max $r_{DS(on)}$ = 34.5mΩ at $V_{GS}$ = -4.5V, $I_D$ = -5.6A
- High power and handing capability in a widely used surface mount package
- Fast switching speed

### General Description

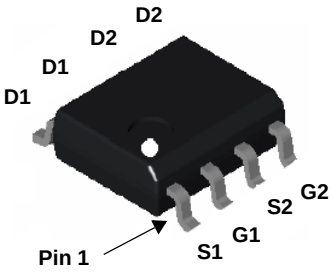
These dual N and P-Channel enhancement mode power MOSFETs are produced using Fairchild Semiconductor's advanced PowerTrench process that has been especially tailored to minimize on-state resistance and yet maintain superior switching performance.

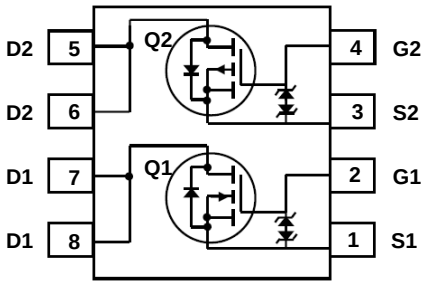
These devices are well suited for low voltage and battery powered applications where low in-line power loss and fast switching are required.

### Application

- Inverter
- Synchronous Buck

SO-8




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

| Symbol | Parameter | | | Q1 | Q2 | Units |
|---|---|---|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | | | 30 | -30 | V |
| $V_{GS}$ | Gate to Source Voltage | | | ±20 | ±25 | V |
| $I_D$ | Drain Current - Continuous | $T_A$ = 25°C | | 8.6 | -7.3 | A |
| | - Pulsed | | | 20 | -20 | |
| $P_D$ | Power Dissipation for Dual Operation | | | 2.0 | | W |
| | Power Dissipation for Single Operation | $T_A$ = 25°C | (Note 1a) | 1.6 | | |
| | | $T_A$ = 25°C | (Note 1c) | 0.9 | | |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | | | -55 to +150 | | °C |

### Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | (Note 1) | 40 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1a) | 78 | |

### Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FDS8858CZ | FDS8858CZ | SO-8 | 13" | 12mm | 2500 units |

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

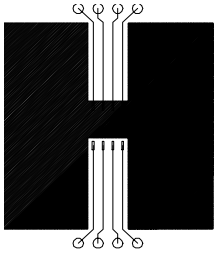
| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = 250μA, $V_{GS}$ = 0V<br>$I_D$ = -250μA, $V_{GS}$ = 0V | Q1<br>Q2 | 30<br>-30 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250μA, referenced to 25°C<br>$I_D$ = -250μA, referenced to 25°C | Q1<br>Q2 | | 22<br>22 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 24V, $V_{GS}$ = 0V<br>$V_{DS}$ = -24V, $V_{GS}$ = 0V | Q1<br>Q2 | | | 1<br>-1 | μA |
| $I_{GSS}$ | Gate to Source Leakage Current | $V_{GS}$ = ±20V, $V_{DS}$ = 0V<br>$V_{GS}$ = ±25V, $V_{DS}$ = 0V | Q1<br>Q2 | | | ±10<br>±10 | μA |
| **On Characteristics** | | | | | | | |
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250μA<br>$V_{GS}$ = $V_{DS}$, $I_D$ = -250μA | Q1<br>Q2 | 1<br>-1 | 1.6<br>-2.1 | 3<br>-3 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D$ = 250μA, referenced to 25°C<br>$I_D$ = -250μA, referenced to 25°C | Q1<br>Q2 | | -5.4<br>-6.0 | | mV/°C |
| $r_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 10V, $I_D$ = 8.6A<br>$V_{GS}$ = 4.5V, $I_D$ = 7.3A<br>$V_{GS}$ = 10V, $I_D$ = 8.6A, $T_J$ = 125°C | Q1 | | 12.4<br>15.2<br>17.7 | 17.0<br>20.0<br>24.3 | mΩ |
| | | $V_{GS}$ = -10V, $I_D$ = -7.3A<br>$V_{GS}$ = -4.5V, $I_D$ = -5.6A<br>$V_{GS}$ = -10V, $I_D$ = -7.3A, $T_J$ = 125°C | Q2 | | 17.1<br>26.5<br>24.0 | 20.5<br>34.5<br>28.8 | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 5V, $I_D$ = 8.6A<br>$V_{DS}$ = -5V, $I_D$ = -7.3A | Q1<br>Q2 | | 27<br>21 | | S |
| **Dynamic Characteristics** | | | | | | | |
| $C_{iss}$ | Input Capacitance | Q1<br>$V_{DS}$ = 15V, $V_{GS}$ = 0V, f = 1MHZ<br>Q2<br>$V_{DS}$ = -15V, $V_{GS}$ = 0V, f = 1MHZ | Q1<br>Q2 | | 905<br>1675 | 1205<br>2230 | pF |
| $C_{oss}$ | Output Capacitance | | Q1<br>Q2 | | 180<br>290 | 240<br>390 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | Q1<br>Q2 | | 110<br>260 | 165<br>390 | pF |
| $R_g$ | Gate Resistance | f = 1MHz | Q1<br>Q2 | | 1.3<br>4.4 | | Ω |
| **Switching Characteristics** | | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | Q1<br>$V_{DD}$ = 15V, $I_D$ = 8.6A,<br>$V_{GS}$ = 10V, $R_{GEN}$ = 6Ω<br>Q2<br>$V_{DD}$ = -15V, $I_D$ = -7.3A,<br>$V_{GS}$ = -10V, $R_{GEN}$ = 6Ω | Q1<br>Q2 | | 7<br>9 | 14<br>18 | ns |
| $t_r$ | Rise Time | | Q1<br>Q2 | | 3<br>10 | 10<br>20 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | Q1<br>Q2 | | 19<br>33 | 35<br>53 | ns |
| $t_f$ | Fall Time | | Q1<br>Q2 | | 3<br>16 | 10<br>29 | ns |
| $Q_{g(TOT)}$ | Total Gate Charge | Q1<br>$V_{GS}$ = 10V, $V_{DD}$ = 15V, $I_D$ = 8.6A<br>Q2<br>$V_{GS}$ = -10V, $V_{DD}$ = -15V, $I_D$ = -7.3A | Q1<br>Q2 | | 17<br>33 | 24<br>46 | nC |
| $Q_{gs}$ | Gate to Source Charge | | Q1<br>Q2 | | 2.7<br>6.1 | | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | Q1<br>Q2 | | 3.4<br>8.5 | | nC |

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

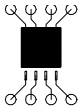
| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **Drain-Source Diode Characteristics** | | | | | | | |
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS}$ = 0V, $I_S$ = 8.6A (Note 2)<br>$V_{GS}$ = 0V, $I_S$ = -7.3A (Note 2) | Q1<br>Q2 | | 0.8<br>0.9 | 1.2<br>-1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | Q1<br>$I_F$ = 8.6A, di/dt = 100A/s | Q1<br>Q2 | | 25<br>28 | 38<br>42 | ns |
| $Q_{rr}$ | Reverse Recovery Charge | Q2<br>$I_F$ = -7.3A, di/dt = 100A/s | Q1<br>Q2 | | 19<br>22 | 29<br>33 | nC |

Notes:

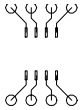
1. $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.



a) 78°C/W when mounted on a 0.5 $in^2$ pad of 2 oz copper



b) 125°C/W when mounted on a 0.02 $in^2$ pad of 2 oz copper



c) 135°C/W when mounted on a minimun pad

**Scale 1 : 1 on letter size paper**

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

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

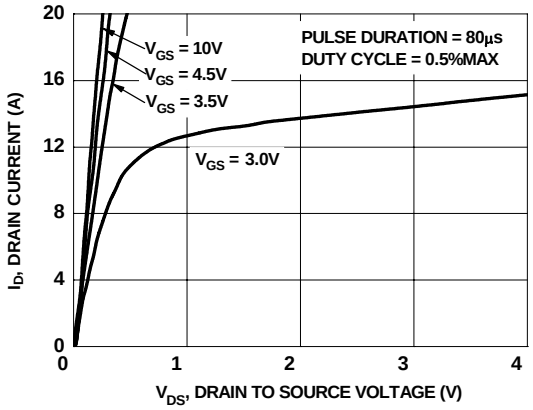



**Figure 1. On- Region Characteristics**

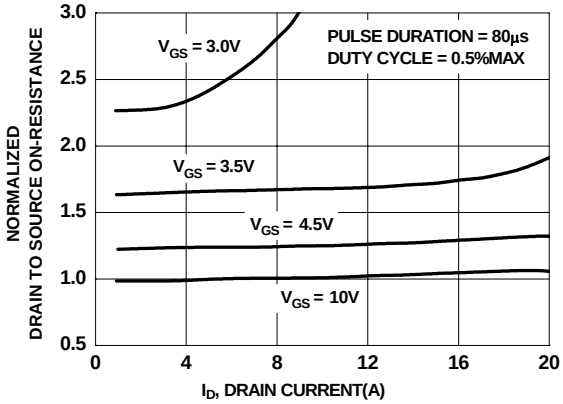



**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**

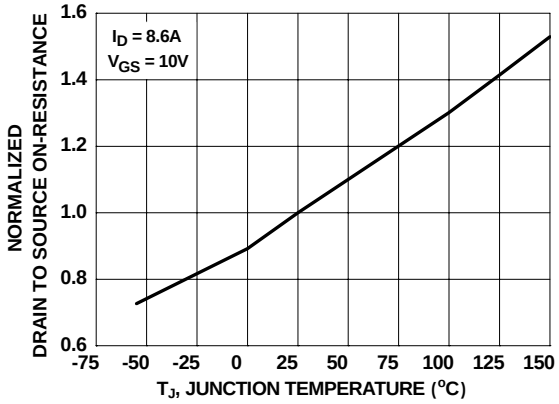



**Figure 3. Normalized On - Resistance vs Junction Temperature**

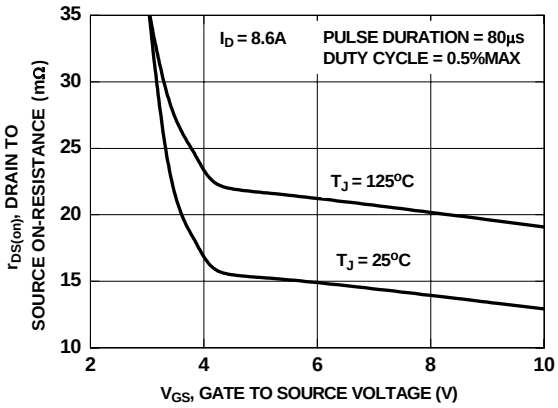



**Figure 4. On-Resistance vs Gate to Source Voltage**

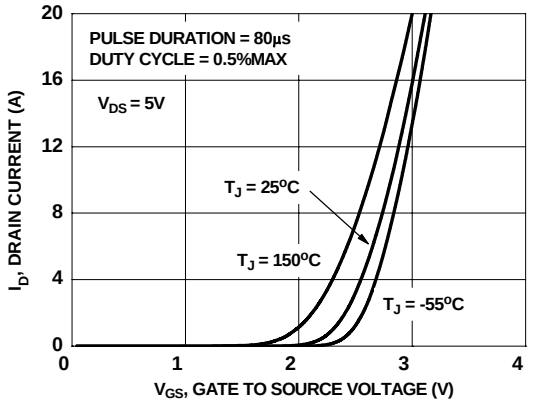



**Figure 5. Transfer Characteristics**

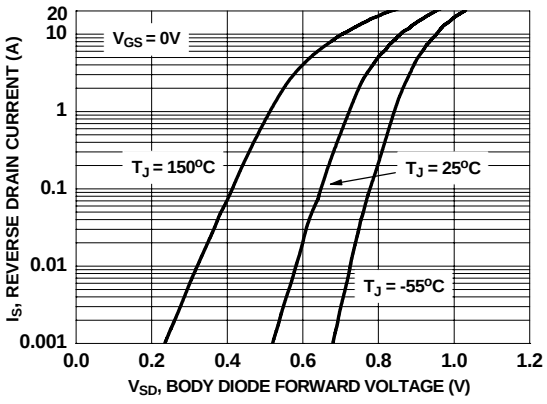



**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

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

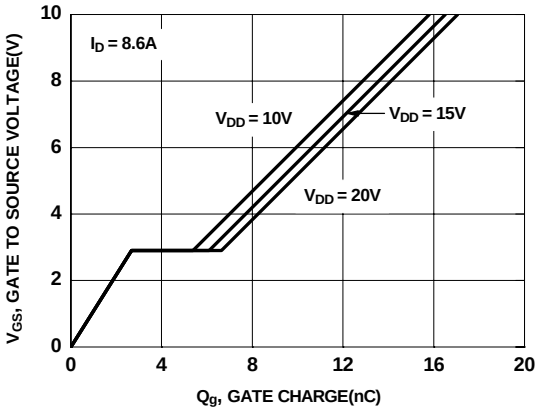



**Figure 7. Gate Charge Characteristics**

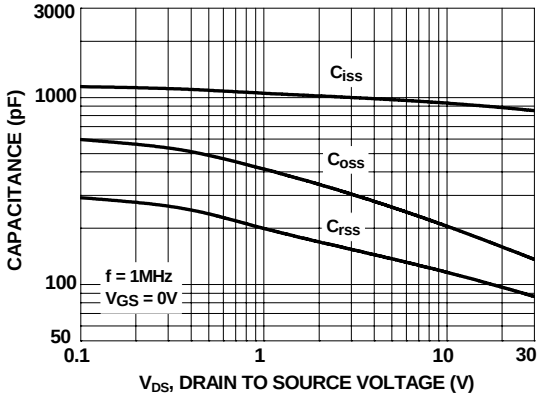



**Figure 8. Capacitance vs Drain to Source Voltage**

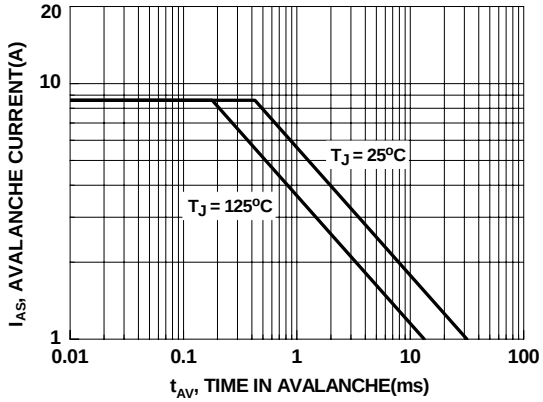



**Figure 9. Unclamped Inductive Switching Capability**

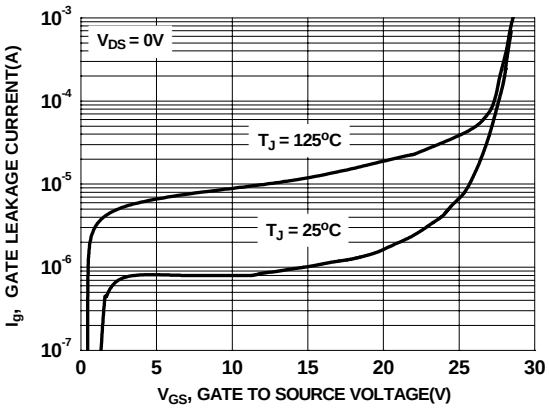



**Figure 10. Gate Leakage Current vs Gate to Source Voltage**

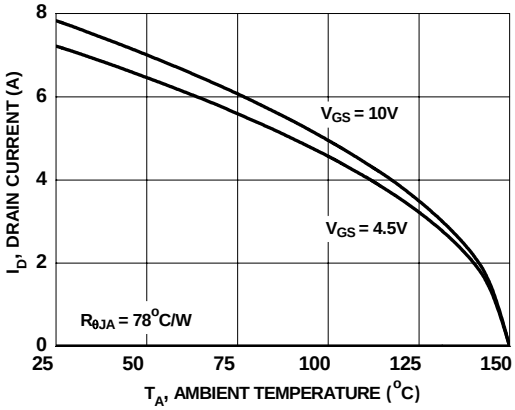



**Figure 11. Maximum Continuous Drain Current vs Ambient Temperature**

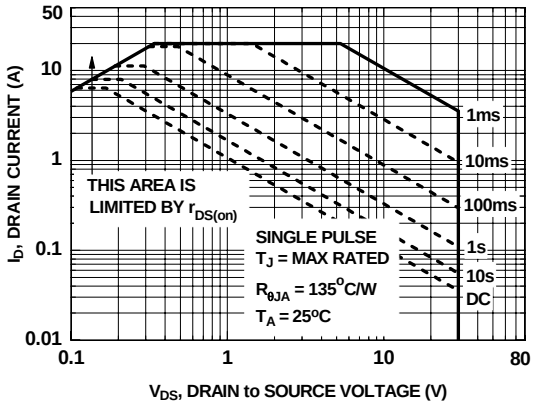



**Figure 12. Forward Bias Safe Operating Area**

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

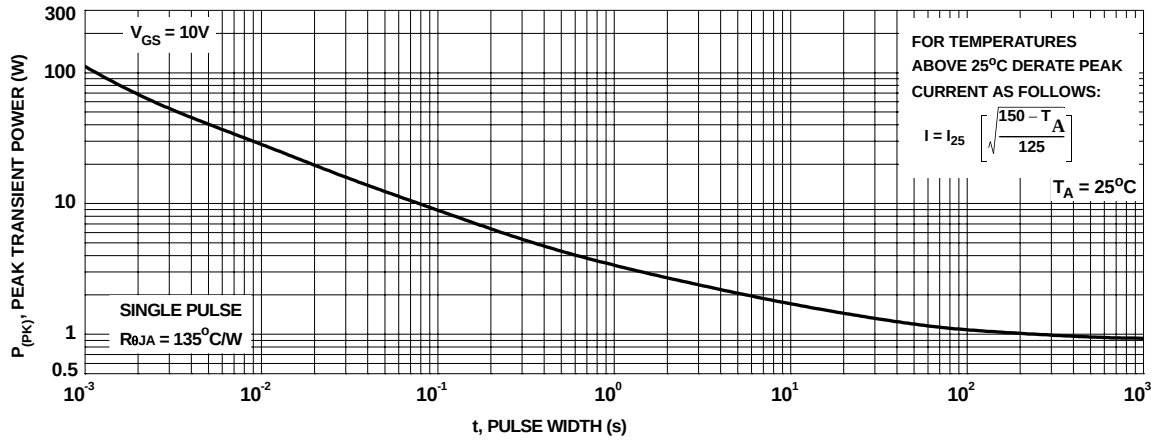



**Figure 13. Single Pulse Maximum Power Dissipation**

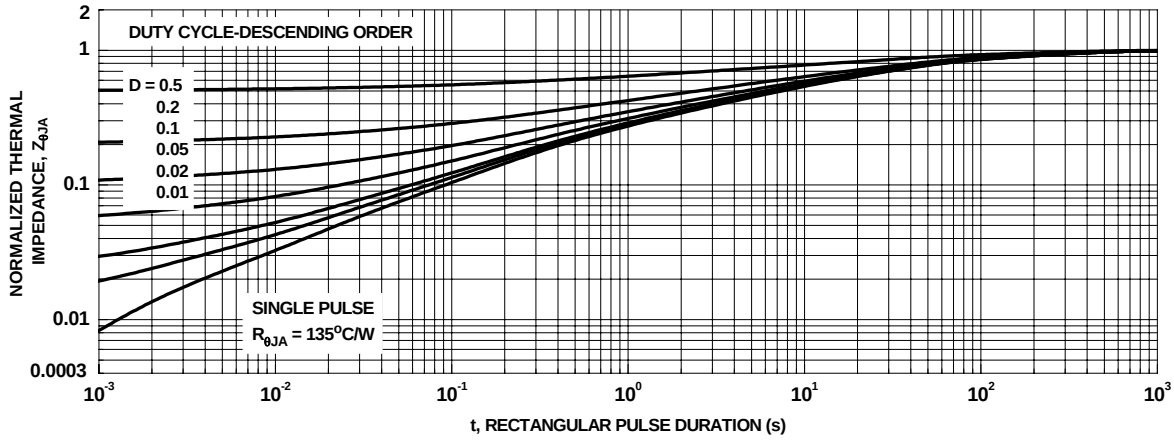



**Figure 14. Transient Thermal Response Curve**

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

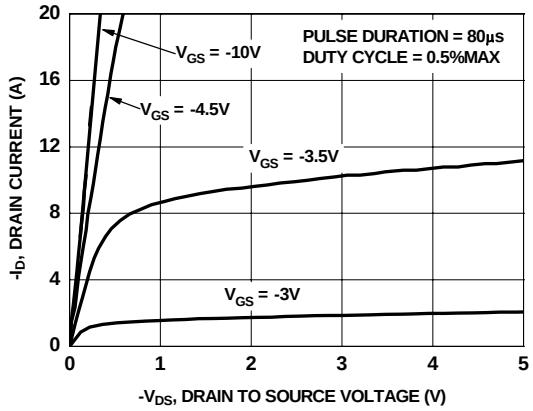



**Figure 15. On- Region Characteristics**

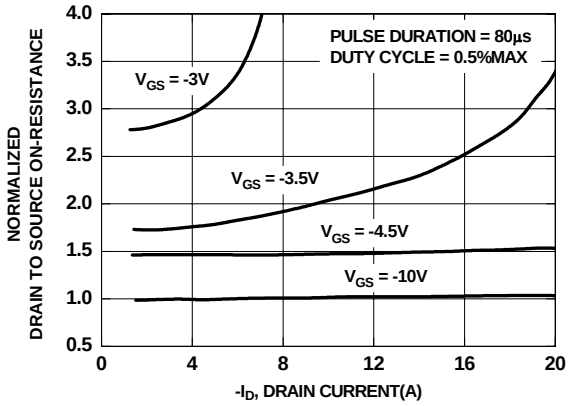



**Figure 16. Normalized on-Resistance vs Drain Current and Gate Voltage**

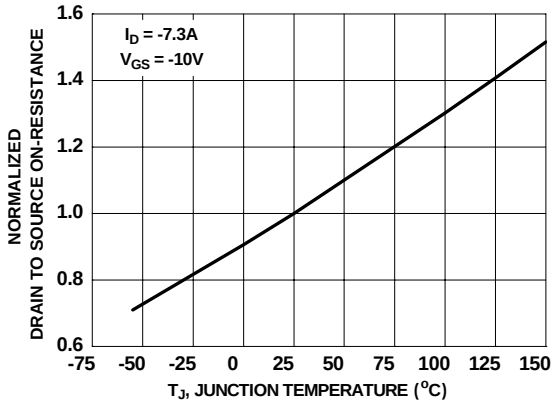



**Figure 17. Normalized On- Resistance vs Junction Temperature**

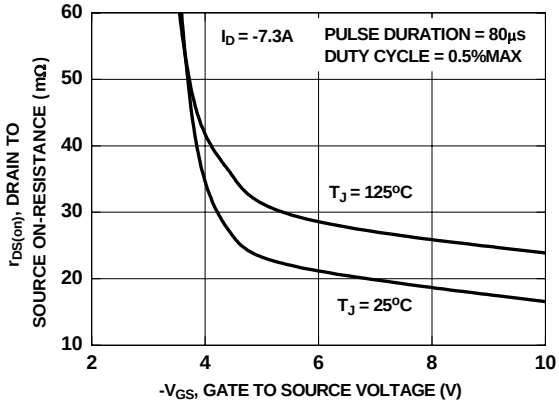



**Figure 18. On-Resistance vs Gate to Source Voltage**

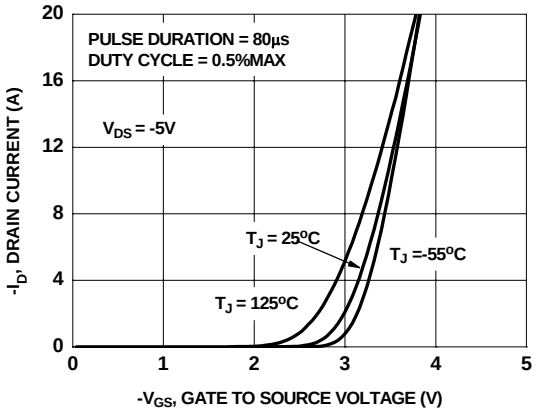



**Figure 19. Transfer Characteristics**

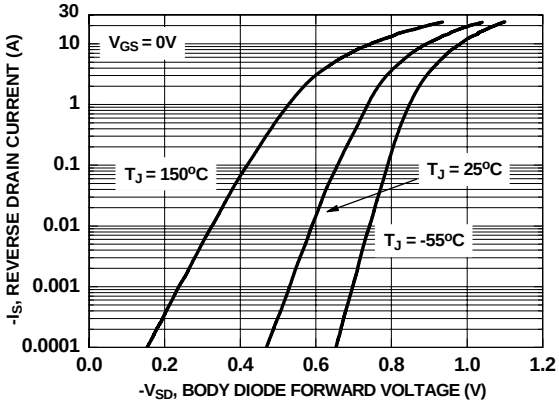



**Figure 20. Source to Drain Diode Forward Voltage vs Source Current**

## Typical Characteristics(Q2 P-Channel) $T_J = 25^oC$ unless otherwise noted

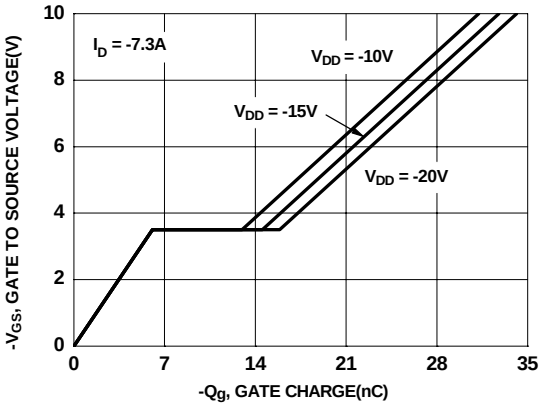



**Figure 21. Gate Charge Characteristics**

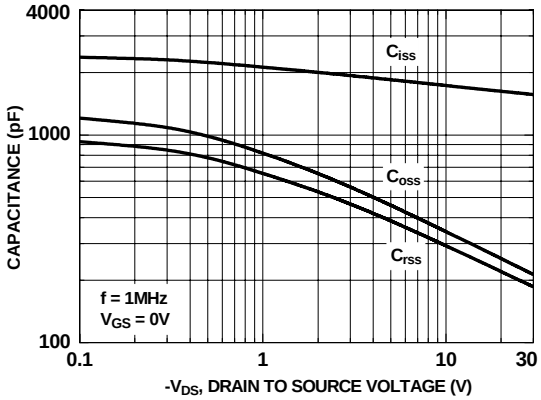



**Figure 22. Capacitance vs Drain to Source Voltage**

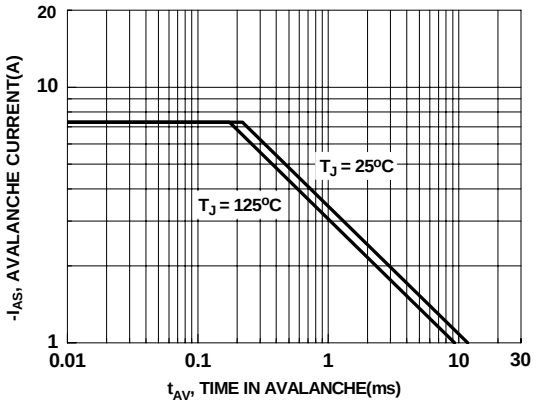



**Figure 23. Unclamped Inductive Switching Capability**

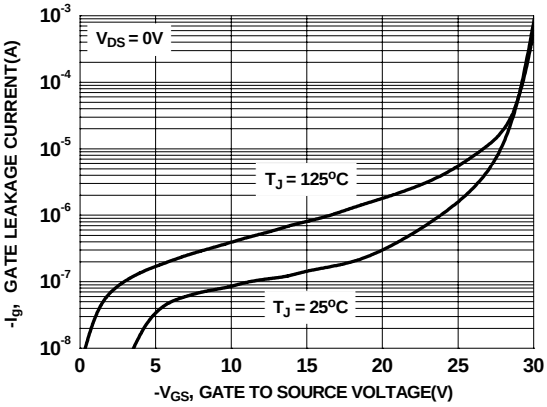



**Figure 24. Gate Leakage Current vs Gate to Source Voltage**

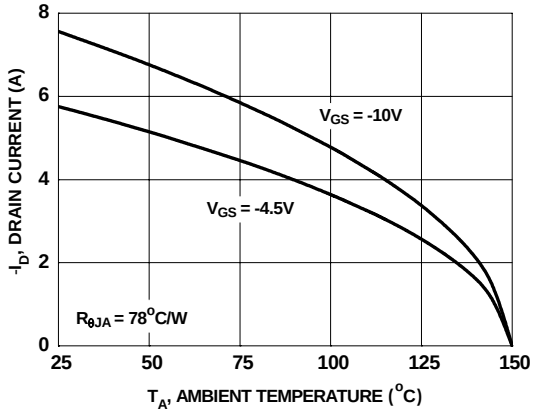



**Figure 25. Maximum Continuous Drain Current vs Ambient Temperature**

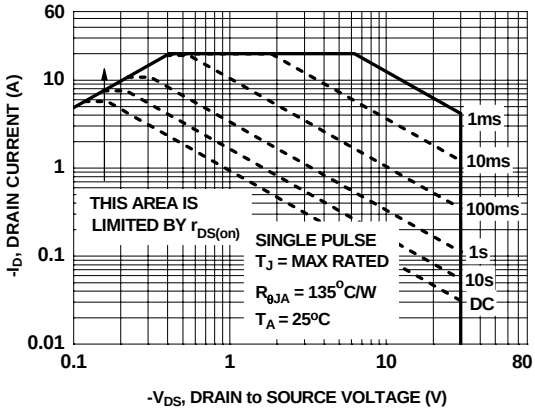



**Figure 26. Forward Bias Safe Operating Area**

## Typical Characteristics(Q2 P-Channel) $T_J = 25^oC$ unless otherwise noted

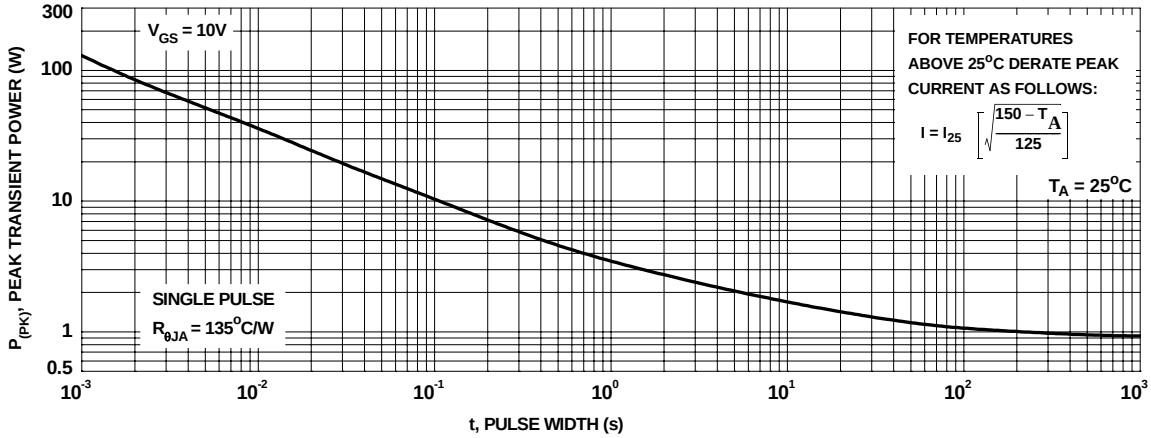



**Figure 27. Single Pulse Maximum Power Dissipation**

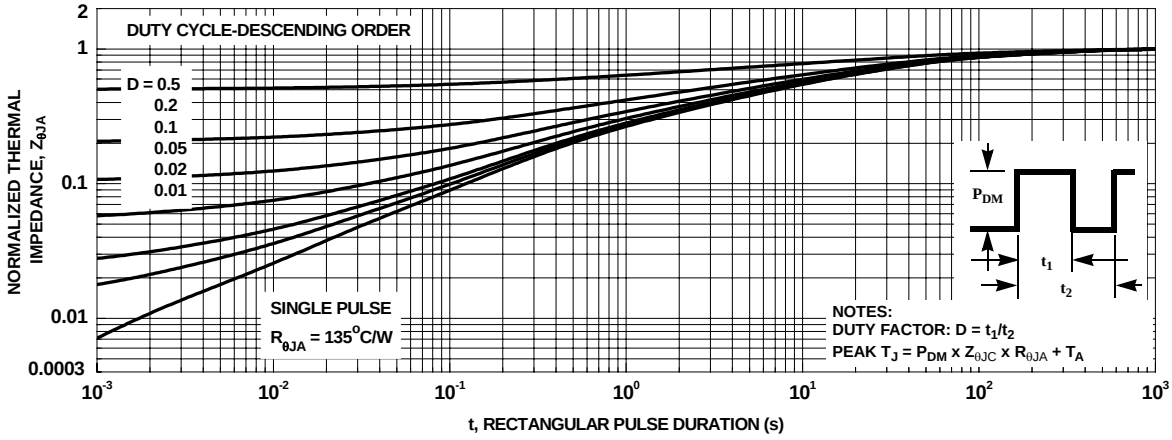



**Figure 28. Transient Thermal Response Curve**

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| ActiveArray™ | ImpliedDisconnect™ | QS™ | TinyPower™ |
| Bottomless™ | IntelliMAX™ | QT Optoelectronics™ | TinyWire™ |
| Build it Now™ | ISOPLANAR™ | Quiet Series™ | TruTranslation™ |
| CoolFET™ | MICROCOUPLER™ | RapidConfigure™ | µSerDes™ |
| *CROSSVOLT*™ | MicroPak™ | RapidConnect™ | UHC® |
| CTL™ | MICROWIRE™ | ScalarPump™ | UniFET™ |
| Current Transfer Logic™ | MSX™ | SMART START™ | VCX™ |
| DOME™ | MSXPro™ | SPM® | Wire™ |
| $E^2$CMOS™ | OCX™ | STEALTH™ | |
| EcoSPARK® | OCXPro™ | SuperFET™ | |
| EnSigna™ | OPTOLOGIC® | SuperSOT™-3 | |
| FACT Quiet Series™ | OPTOPLANAR® | SuperSOT™-6 | |
| FACT® | PACMAN™ | SuperSOT™-8 | |
| FAST® | POP™ | SyncFET™ | |
| FASTr™ | Power220® | TCM™ | |
| FPS™ | Power247® | The Power Franchise® | |
| FRFET® | PowerEdge™ | ™ | |
| GlobalOptoisolator™ | PowerSaver™ | TinyBoost™ | |
| GTO™ | PowerTrench® | TinyBuck™ | |



**PRODUCT STATUS DEFINITIONS**
**Definition of Terms**

| Datasheet Identification | Product Status | Definition |
|---|---|---|
| Advance Information | Formative or In Design | This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. |
| Preliminary | First Production | This datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production | This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| Obsolete | Not In Production | This datasheet contains specifications on a product that has been discontinued by Fairchild Semiconductor.The datasheet is printed for reference information only. |

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