

# 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 handling capability in a widely used surface mount package
- Fast switching speed



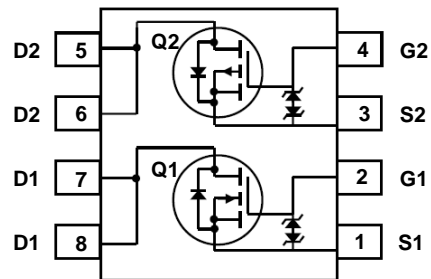
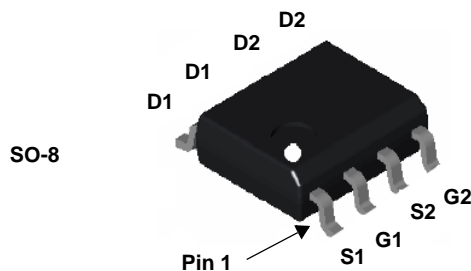
### General Description

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



### MOSFET Maximum Ratings $T_A = 25^\circ\text{C}$ unless otherwise noted

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

### Thermal Characteristics

|                 |   |           |    |                    |
|-----------------|---|-----------|----|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case    | (Note 1)  | 40 | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | 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**  $T_J = 25^\circ\text{C}$  unless otherwise noted

| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|--------|-----------|-----------------|------|-----|-----|-----|-------|
|--------|-----------|-----------------|------|-----|-----|-----|-------|

**Off Characteristics**

|                                      |   |   |          |           |          |                      |                      |
|--------------------------------------|---|---|----------|-----------|----------|----------------------|----------------------|
| $BV_{DSS}$                           | Drain to Source Breakdown Voltage         | $I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$<br>$I_D = -250\mu\text{A}, V_{GS} = 0\text{V}$                               | Q1<br>Q2 | 30<br>-30 |          |                      | V                    |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\mu\text{A}$ , referenced to $25^\circ\text{C}$<br>$I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$ | Q1<br>Q2 |           | 22<br>22 |                      | mV/ $^\circ\text{C}$ |
| $I_{DSS}$                            | Zero Gate Voltage Drain Current           | $V_{DS} = 24\text{V}, V_{GS} = 0\text{V}$<br>$V_{DS} = -24\text{V}, V_{GS} = 0\text{V}$                                 | Q1<br>Q2 |           |          | 1<br>-1              | $\mu\text{A}$        |
| $I_{GSS}$                            | Gate to Source Leakage Current            | $V_{GS} = \pm 20\text{V}, V_{DS} = 0\text{V}$<br>$V_{GS} = \pm 25\text{V}, V_{DS} = 0\text{V}$                          | Q1<br>Q2 |           |          | $\pm 10$<br>$\pm 10$ | $\mu\text{A}$        |

**On Characteristics**

|  |  |  |          |         |                      |                      |                      |
|--|--|--|----------|---------|----------------------|----------------------|----------------------|
| $V_{GS(th)}$                           | Gate to Source Threshold Voltage                         | $V_{GS} = V_{DS}, I_D = 250\mu\text{A}$<br>$V_{GS} = V_{DS}, I_D = -250\mu\text{A}$  | 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 | $I_D = 250\mu\text{A}$ , referenced to $25^\circ\text{C}$<br>$I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$  | Q1<br>Q2 |         | -5.4<br>-6.0         |                      | mV/ $^\circ\text{C}$ |
| $r_{DS(on)}$                           | Static Drain to Source On Resistance                     | $V_{GS} = 10\text{V}, I_D = 8.6\text{A}$<br>$V_{GS} = 4.5\text{V}, I_D = 7.3\text{A}$<br>$V_{GS} = 10\text{V}, I_D = 8.6\text{A}, T_J = 125^\circ\text{C}$       | Q1       |         | 12.4<br>15.2<br>17.7 | 17.0<br>20.0<br>24.3 | m $\Omega$           |
|  |  | $V_{GS} = -10\text{V}, I_D = -7.3\text{A}$<br>$V_{GS} = -4.5\text{V}, I_D = -5.6\text{A}$<br>$V_{GS} = -10\text{V}, I_D = -7.3\text{A}, T_J = 125^\circ\text{C}$ | Q2       |         | 17.1<br>26.5<br>24.0 | 20.5<br>34.5<br>28.8 |                      |
| $g_{FS}$                               | Forward Transconductance                                 | $V_{DS} = 5\text{V}, I_D = 8.6\text{A}$<br>$V_{DS} = -5\text{V}, I_D = -7.3\text{A}$   | Q1<br>Q2 |         | 27<br>21             |                      | S                    |

**Dynamic Characteristics**

|            |                              |  |          |  |             |              |          |
|------------|------------------------------|--|----------|--|-------------|--------------|----------|
| $C_{iss}$  | Input Capacitance            | Q1<br>$V_{DS} = 15\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$ | Q1<br>Q2 |  | 905<br>1675 | 1205<br>2230 | pF       |
| $C_{oss}$  | Output Capacitance           | Q2   | Q1<br>Q2 |  | 180<br>290  | 240<br>390   | pF       |
| $C_{riss}$ | Reverse Transfer Capacitance | $V_{DS} = -15\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$      | Q1<br>Q2 |  | 110<br>260  | 165<br>390   | pF       |
| $R_g$      | Gate Resistance              | $f = 1\text{MHz}$  | Q1       |  | 1.3         |              | $\Omega$ |
|            |                              |  | Q2       |  | 4.4         |              |          |

**Switching Characteristics**

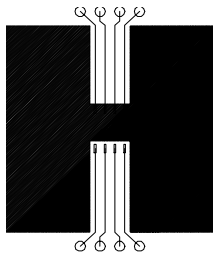
|              |                               |  |    |  |     |    |    |
|--------------|-------------------------------|--|----|--|-----|----|----|
| $t_{d(on)}$  | Turn-On Delay Time            | Q1<br>$V_{DD} = 15\text{V}, I_D = 8.6\text{A},$<br>$V_{GS} = 10\text{V}, R_{GEN} = 6\Omega$    | Q1 |  | 7   | 14 | ns |
|              |                               |  | Q2 |  | 9   | 18 |    |
| $t_r$        | Rise Time                     | Q1<br>$V_{DD} = 15\text{V}, I_D = 8.6\text{A},$<br>$V_{GS} = 10\text{V}, R_{GEN} = 6\Omega$    | Q1 |  | 3   | 10 | ns |
|              |                               |  | Q2 |  | 10  | 20 |    |
| $t_{d(off)}$ | Turn-Off Delay Time           | Q2<br>$V_{DD} = -15\text{V}, I_D = -7.3\text{A},$<br>$V_{GS} = -10\text{V}, R_{GEN} = 6\Omega$ | Q1 |  | 19  | 35 | ns |
|              |                               |  | Q2 |  | 33  | 53 |    |
| $t_f$        | Fall Time                     | Q1<br>$V_{DD} = -15\text{V}, I_D = -7.3\text{A},$<br>$V_{GS} = -10\text{V}, R_{GEN} = 6\Omega$ | Q1 |  | 3   | 10 | ns |
|              |                               |  | Q2 |  | 16  | 29 |    |
| $Q_{g(TOT)}$ | Total Gate Charge             | Q1<br>$V_{GS} = 10\text{V}, V_{DD} = 15\text{V}, I_D = 8.6\text{A}$                            | Q1 |  | 17  | 24 | nC |
|              |                               |  | Q2 |  | 33  | 46 |    |
| $Q_{gs}$     | Gate to Source Charge         | Q1<br>$V_{GS} = 10\text{V}, V_{DD} = 15\text{V}, I_D = 8.6\text{A}$                            | Q1 |  | 2.7 |    | nC |
|              |                               |  | Q2 |  | 6.1 |    |    |
| $Q_{gd}$     | Gate to Drain "Miller" Charge | Q1<br>$V_{GS} = -10\text{V}, V_{DD} = -15\text{V}, I_D = -7.3\text{A}$                         | Q1 |  | 3.4 |    | nC |
|              |                               |  | Q2 |  | 8.5 |    |    |

### Electrical Characteristics $T_J = 25^\circ\text{C}$ unless otherwise noted

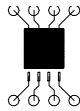
| Symbol                                    | Parameter                             | Test Conditions   | Type     | Min | Typ        | Max         | Units |
|---|---------------------------------------|---|----------|-----|------------|-------------|-------|
| <b>Drain-Source Diode Characteristics</b> |                                       |   |          |     |            |             |       |
| $V_{SD}$                                  | 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:

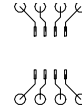
- $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a) 78°C/W when mounted on a 0.5 in<sup>2</sup> pad of 2 oz copper



b) 125°C/W when mounted on a 0.02 in<sup>2</sup> pad of 2 oz copper



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

Scale 1 : 1 on letter size paper

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

**Typical Characteristics (Q1 N-Channel)**  $T_J = 25^\circ\text{C}$  unless otherwise noted

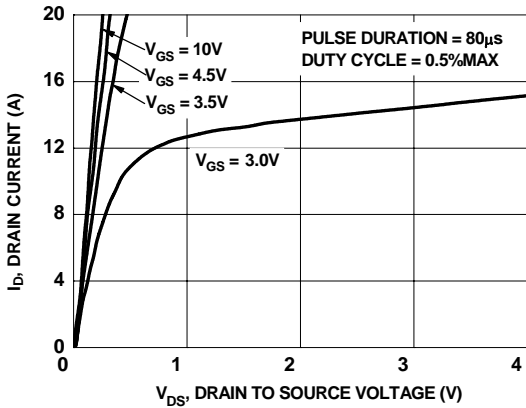


Figure 1. On-Region Characteristics

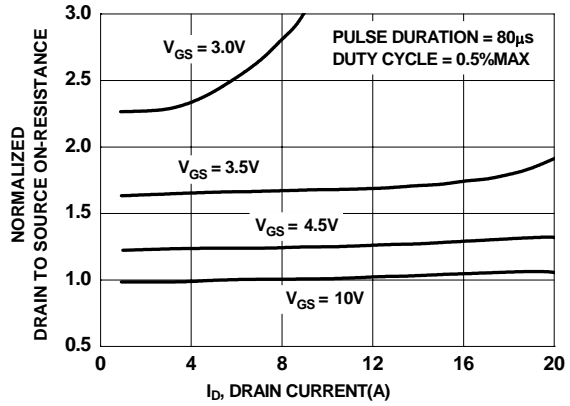


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

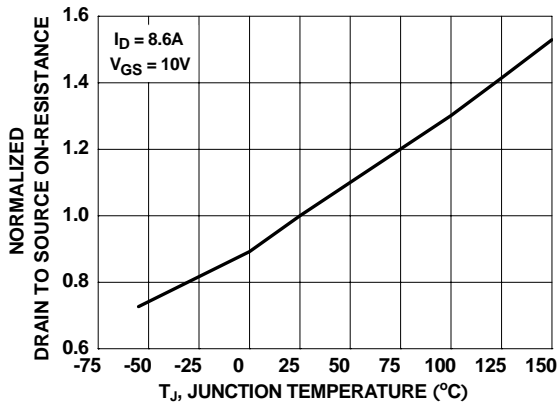


Figure 3. Normalized On-Resistance vs Junction Temperature

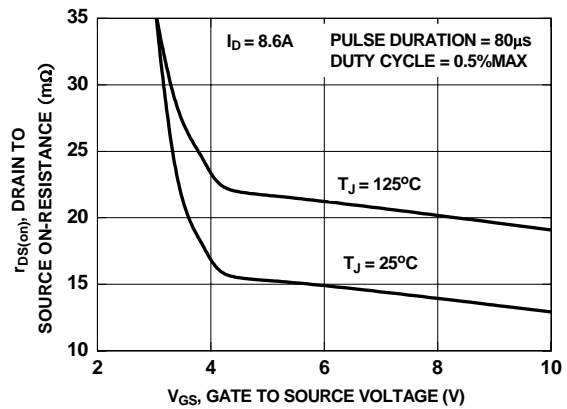


Figure 4. On-Resistance vs Gate to Source Voltage

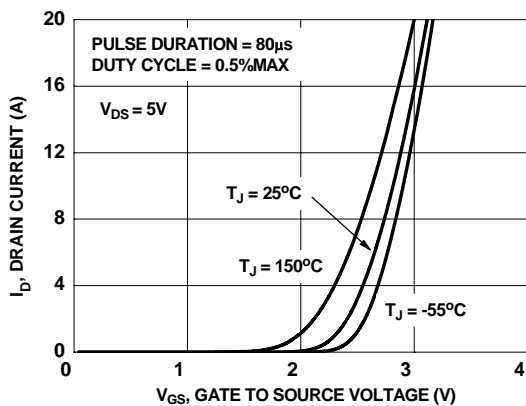


Figure 5. Transfer Characteristics

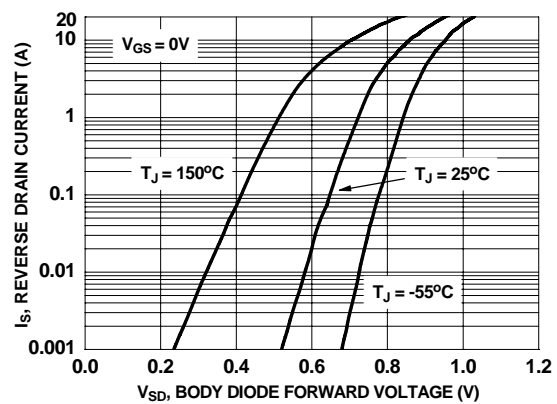
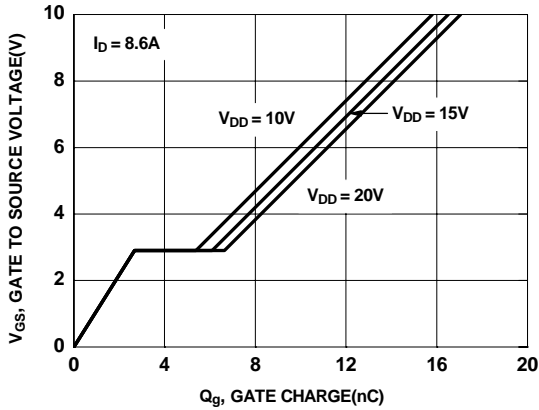
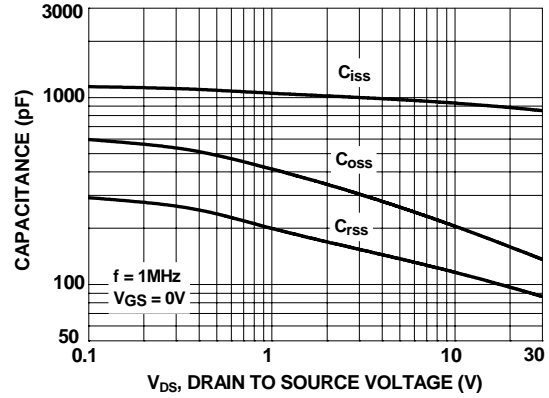


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

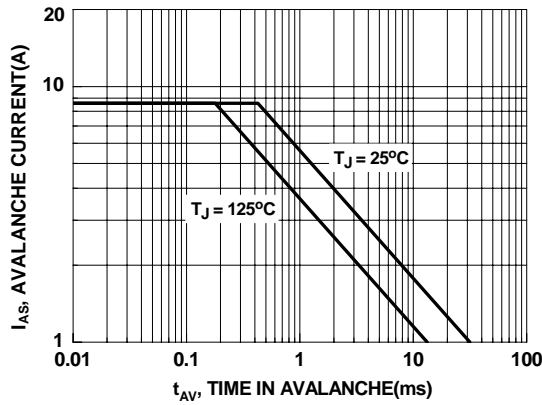
**Typical Characteristics (Q1 N-Channel)**  $T_J = 25^\circ\text{C}$  unless otherwise noted



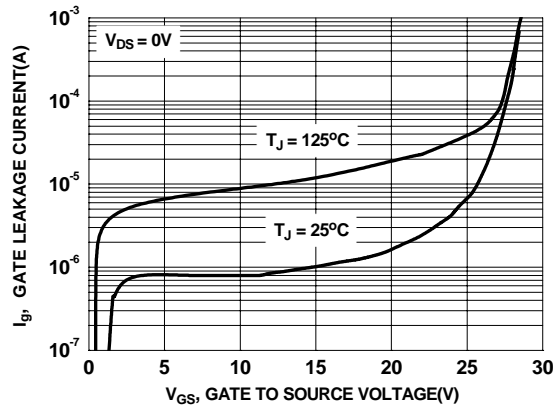
**Figure 7. Gate Charge Characteristics**



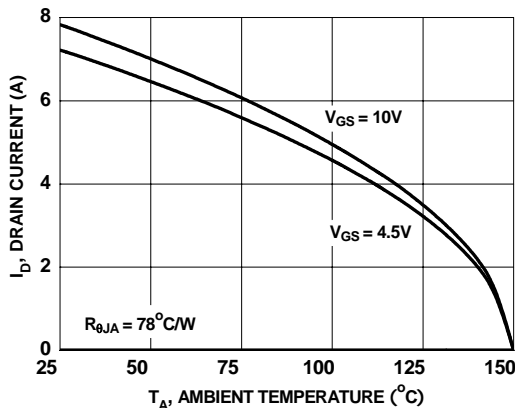
**Figure 8. Capacitance vs Drain to Source Voltage**



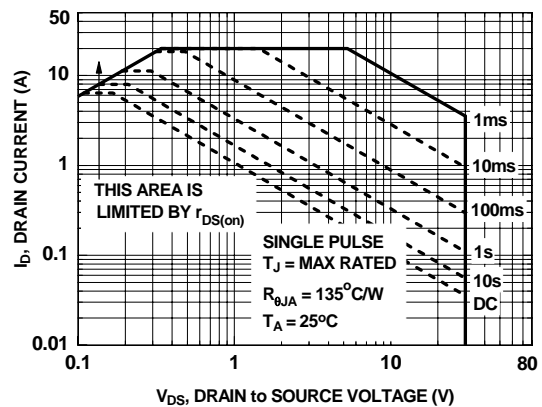
**Figure 9. Unclamped Inductive Switching Capability**



**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)**  $T_J = 25^\circ\text{C}$  unless otherwise noted

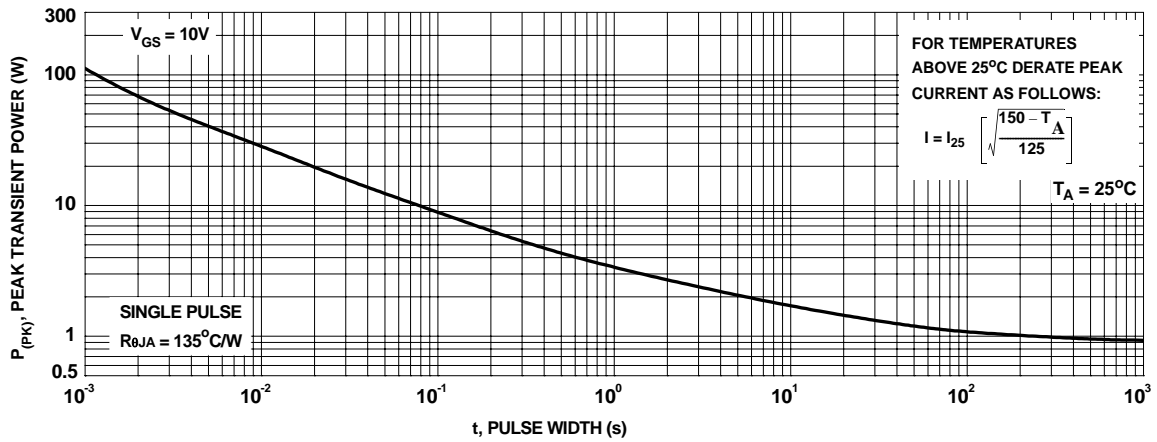


Figure 13. Single Pulse Maximum Power Dissipation

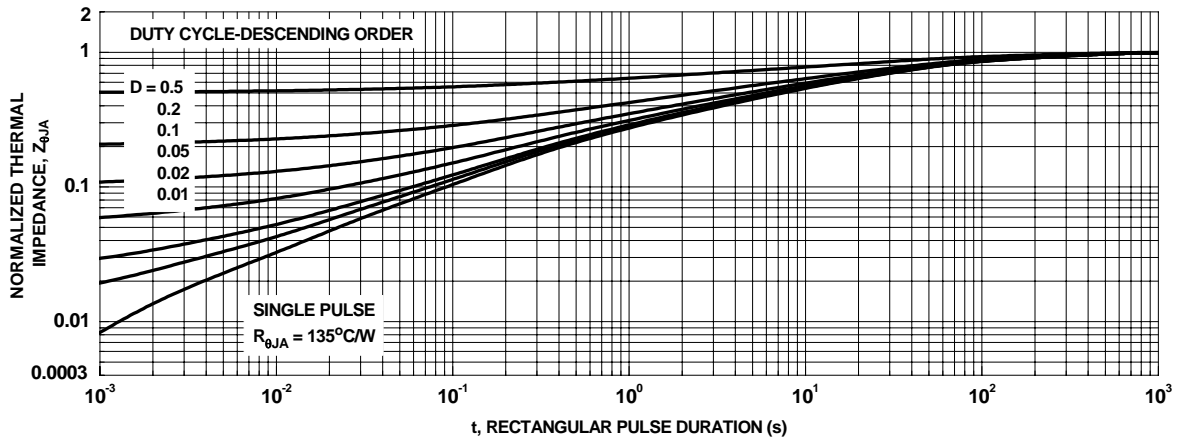
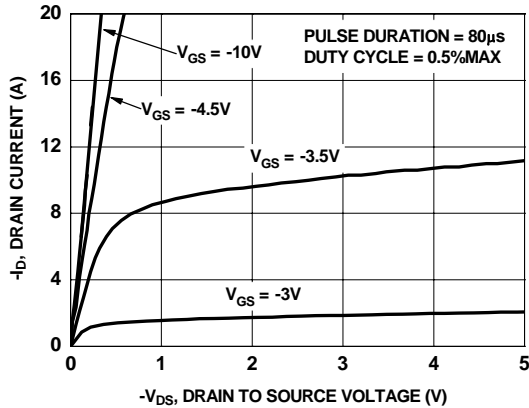
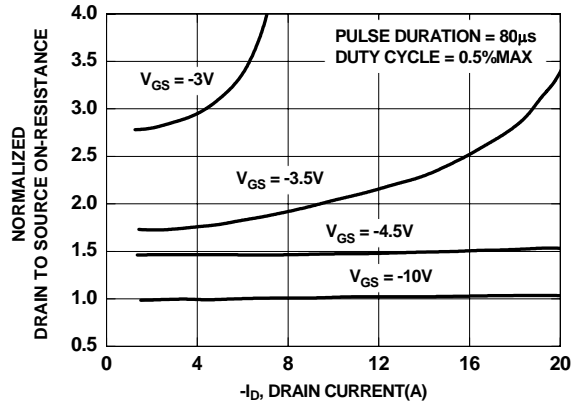


Figure 14. Transient Thermal Response Curve

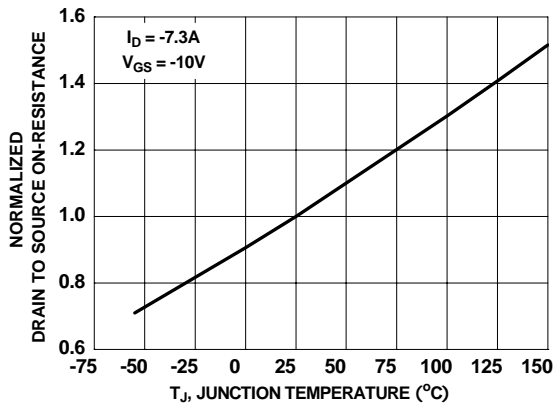
**Typical Characteristics (Q2 P-Channel)**  $T_J = 25^\circ\text{C}$  unless otherwise noted



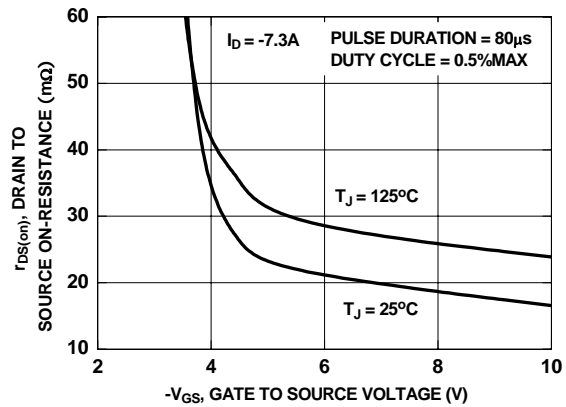
**Figure 15. On- Region Characteristics**



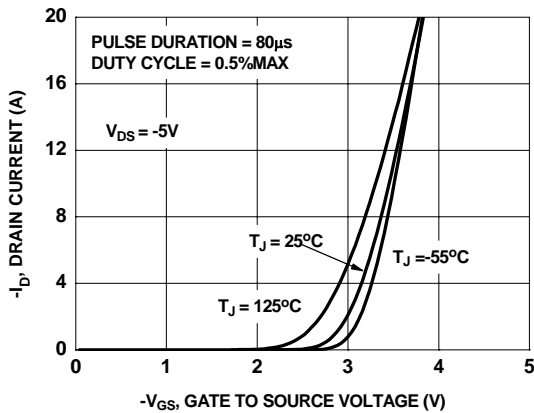
**Figure 16. Normalized on-Resistance vs Drain Current and Gate Voltage**



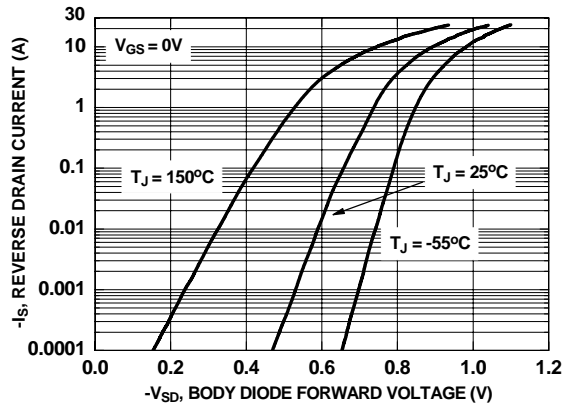
**Figure 17. Normalized On- Resistance vs Junction Temperature**



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

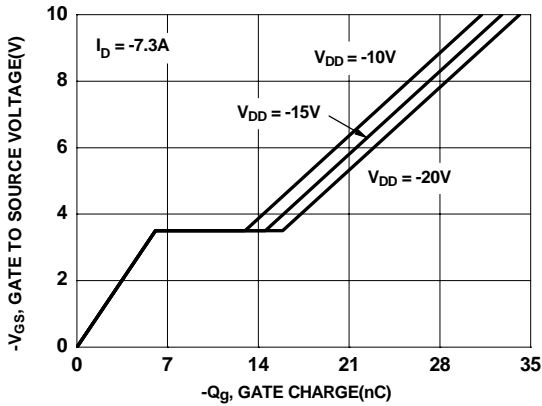


**Figure 19. Transfer Characteristics**

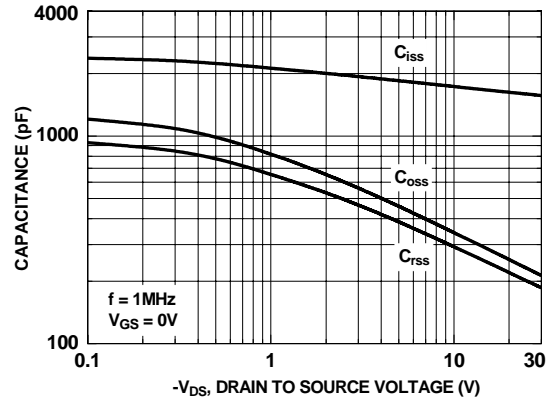


**Figure 20. Source to Drain Diode Forward Voltage vs Source Current**

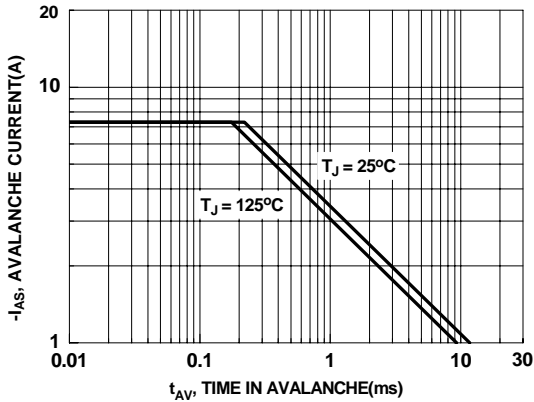
**Typical Characteristics(Q2 P-Channel)**  $T_J = 25^\circ\text{C}$  unless otherwise noted



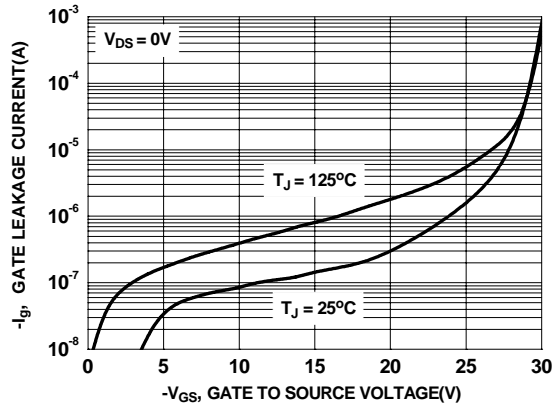
**Figure 21. Gate Charge Characteristics**



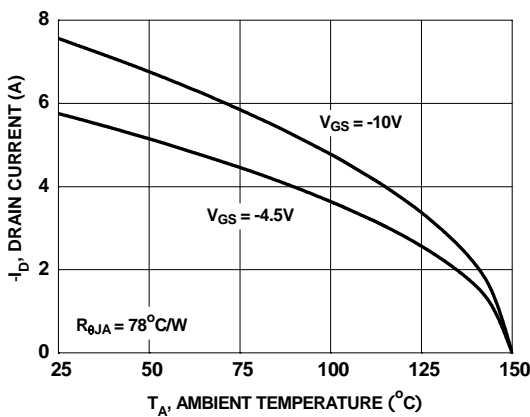
**Figure 22. Capacitance vs Drain to Source Voltage**



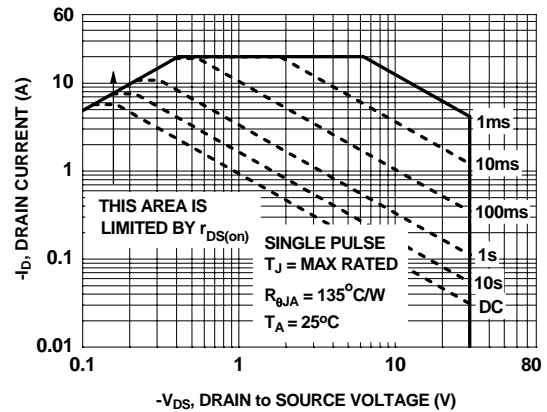
**Figure 23. Unclamped Inductive Switching Capability**



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



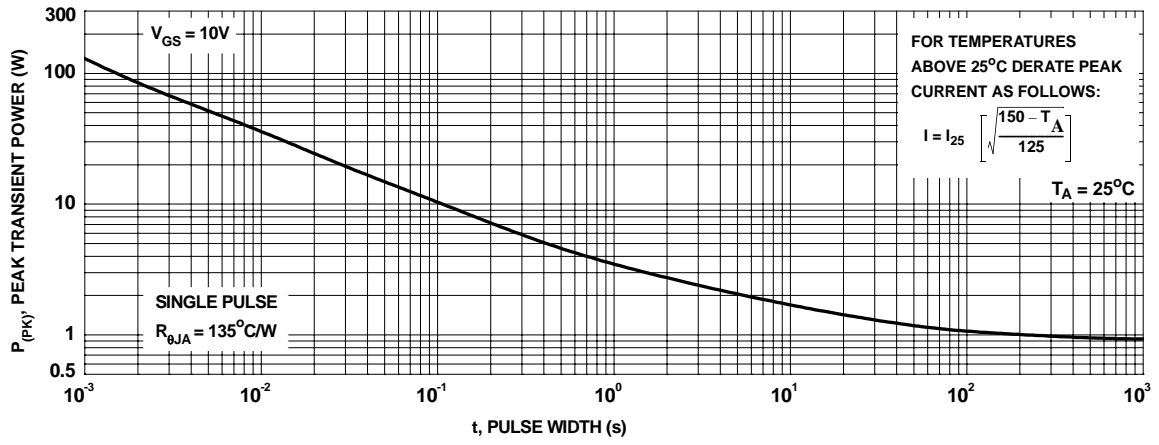
**Figure 25. Maximum Continuous Drain Current vs Ambient Temperature**



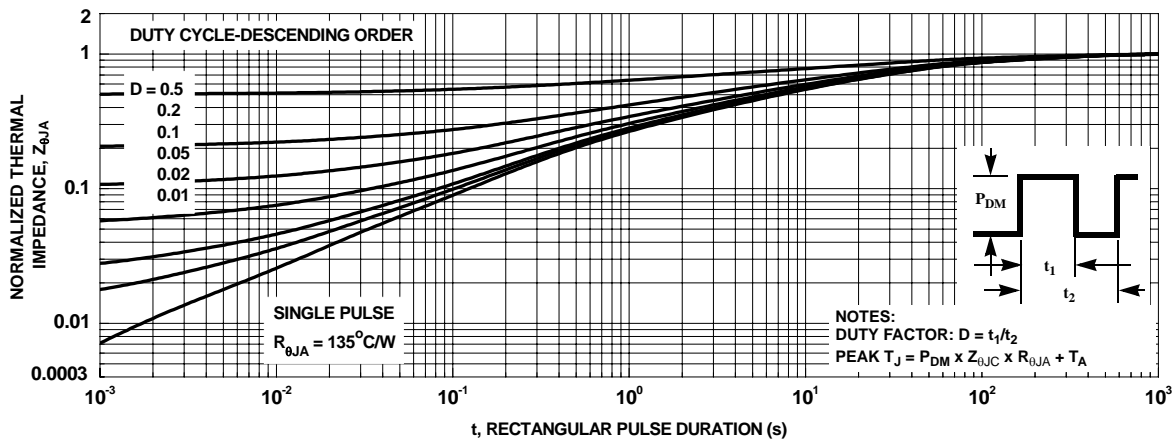
**Figure 26. Forward Bias Safe Operating Area**



**Typical Characteristics(Q2 P-Channel)  $T_J = 25^\circ\text{C}$  unless otherwise noted**



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




**Figure 28. Transient Thermal Response Curve**



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|---|---------------------------------|---|------------------------------|
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| ActiveArray <sup>TM</sup>                         | ImpliedDisconnect <sup>TM</sup> | QS <sup>TM</sup>  | TinyPower <sup>TM</sup>      |
| Bottomless <sup>TM</sup>                          | IntelliMAX <sup>TM</sup>        | QT Optoelectronics <sup>TM</sup>  | TinyWire <sup>TM</sup>       |
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| Current Transfer Logic <sup>TM</sup>              | MSX <sup>TM</sup>               | SMART START <sup>TM</sup>   | VCX <sup>TM</sup>            |
| DOME <sup>TM</sup>                                | MSXPro <sup>TM</sup>            | SPM <sup>®</sup>  | Wire <sup>TM</sup>           |
| E <sup>2</sup> CMOS <sup>TM</sup>                 | OCX <sup>TM</sup>               | STEALTH <sup>TM</sup>   |                              |
| EcoSPARK <sup>®</sup>                             | OCXPro <sup>TM</sup>            | SuperFET <sup>TM</sup>  |                              |
| EnSigna <sup>TM</sup>                             | OPTOLOGIC <sup>®</sup>          | SuperSOT <sup>TM</sup> -3   |                              |
| FACT Quiet Series <sup>TM</sup>                   | OPTOPLANAR <sup>®</sup>         | SuperSOT <sup>TM</sup> -6   |                              |
| FACT <sup>®</sup>                                 | PACMAN <sup>TM</sup>            | SuperSOT <sup>TM</sup> -8   |                              |
| FAST <sup>®</sup>                                 | POP <sup>TM</sup>               | SyncFET <sup>TM</sup>   |                              |
| FAST <sub>r</sub> <sup>TM</sup>                   | Power220 <sup>®</sup>           | TCM <sup>TM</sup>   |                              |
| FPS <sup>TM</sup>                                 | Power247 <sup>®</sup>           | The Power Franchise <sup>®</sup>  |                              |
| FRFET <sup>®</sup>                                | PowerEdge <sup>TM</sup>         |  <sup>TM</sup> |                              |
| GlobalOptoisolator <sup>TM</sup>                  | PowerSaver <sup>TM</sup>        | TinyBoost <sup>TM</sup>   |                              |
| GTO <sup>TM</sup>                                 | PowerTrench <sup>®</sup>        | TinyBuck <sup>TM</sup>  |                              |

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As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

**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.   |
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