FAIRCHILD SEMICONDUCTOR®

October 2006

# FDFC2P100

## Integrated P-Channel PowerTrench® MOSFET and Schottky Diode

**-20V, -3A, 150mΩ**

## Features

- Max $r_{DS(on)}$ = 150mΩ at $V_{GS}$ = -4.5V, $I_D$ = -3.0A
- Max $r_{DS(on)}$ = 200mΩ at $V_{GS}$ = -2.5V, $I_D$ = -2.2A
- Low Gate Charge (3.4nC typ)
- Compact industry standard SuperSOT™-6 package

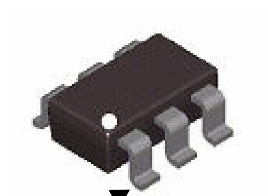
## Schottky:

- $V_F$ < 0.45 V at $I_F$ = 1A
- RoHS Compliant

## General Description

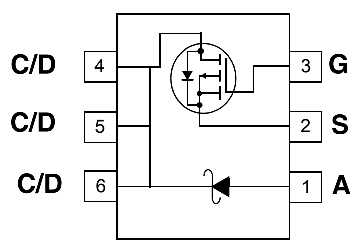
The FDFC2P100 combine the exceptional performance of Fairchild's PowerTrench MOSFET technology with a very low forward voltage drop Schottky barrier rectifier in an SSOT-6 package.

This device is designed specifically as a single package solution for DC to DC converters. It features a fast switching, low gate charge MOSFET with very low on-state resistance. Significant improvement of Thermal Characteristics and Power Dissipation via replacement of independently connected Schottky with internal connection of Schottky Diode Cathode pn to P-Channel PowerTrench MosFET Drain pin.



PIN 1

SuperSOT™-6




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

| Symbol | Parameter | | Ratings | Units |
|---|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | | -20 | V |
| $V_{GS}$ | Gate to Source Voltage | | ±12 | V |
| $I_D$ | Drain Current -Continuous | (Note 1a) | -3 | A |
| | -Pulsed | | -6 | |
| $P_D$ | Power Dissipation | (Note 1a)<br>(Note 1b) | 1.5<br>0.8 | W |
| $V_{RRM}$ | Schotty Repetitive Peak Reverse Voltage | | 20 | V |
| $I_O$ | Schotty Average Forward Current | (Note 1a) | 1 | A |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | | -55 to +150 | °C |

### Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1a) | 87 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1b) | 166 | |

### Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| .100 | FDFC2P100 | SSOT-6 | 7” | 8mm | 3000units |

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

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

### Off Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = -250µA, $V_{GS}$ = 0V | -20 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = -250µA, referenced to 25°C | | -12 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{GS}$ = 0V, $V_{DS}$ = -16V | | | -1 | µA |
| $I_{GSS}$ | Gate to Source Leakage Current | $V_{GS}$ = ±12V, $V_{DS}$ = 0V | | | ±100 | µA |

### On Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = -250µA | -0.6 | -0.9 | -1.5 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D$ = -250µA, referenced to 25°C | | 3 | | mV/°C |
| $r_{DS(on)}$ | Drain to Source On-Resistance | $V_{GS}$ = -4.5V, $I_D$ = -3.0A | | 95 | 150 | mΩ |
| | | $V_{GS}$ = -2.5V, $I_D$ = -2.2A | | 150 | 200 | |
| | | $V_{GS}$ = -4.5V, $I_D$ = -3.0A, $T_J$ = 125°C | | 130 | 252 | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = -5V, $I_D$ = -3.0A | | 5.4 | | S |

### Dynamic Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = -10V, $V_{GS}$ = 0V, f = 1MHz | | 335 | 445 | pF |
| $C_{oss}$ | Output Capacitance | | | 80 | 105 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 40 | 60 | pF |
| $R_g$ | Gate Resistance | f = 1MHz | | 6 | | Ω |

### Switching Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = -10V, $I_D$ = -3.0A, $V_{GS}$ = -4.5V, $R_{GEN}$ = 6Ω | | 9 | 16 | ns |
| $t_r$ | Rise Time | | | 11 | 20 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 12 | 22 | ns |
| $t_f$ | Fall Time | | | 4 | 8 | ns |
| $Q_{g(TOT)}$ | Total Gate Charge at -10V | $V_{GS}$ = 0V to -10V; $V_{DD}$ = -4.5V, $I_D$ = -3.0A | | 3.4 | 4.7 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | | 0.9 | | nC |
| $Q_{gd}$ | Gate to Drain "Miller" Charge | | | 1.0 | | nC |

### Drain-Source Diode Characteristics

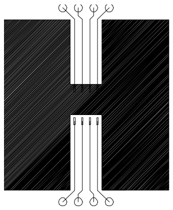
| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $I_S$ | Maximum Continuous Drain tio Source Diode forward Current | | | | -1.2 | A |
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS}$ = 0V, $I_S$ = -1.2A (Note 2) | | -0.8 | -1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = -3.0A, di/dt = 100A/µs | | 17 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 5 | | nC |

### Schottky Diode Characteristics

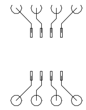
| Symbol | Parameter | Test Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| $I_R$ | Reverse Leakage | $V_R$ = 20V | $T_J$ = 25°C | | 26 | 400 | µA |
| | | | $T_J$ = 100C | | 2.7 | 20 | mA |
| | | $V_R$ = 10V | $T_J$ = 25°C | | 23 | 200 | µA |
| | | | $T_J$ = 100°C | | 2.5 | 10 | mA |
| $V_F$ | Forward Voltage | $I_F$ = 500mA | $T_J$ = 25°C | | 0.31 | 0.4 | V |
| | | | $T_J$ = 100°C | | 0.24 | 0.35 | |
| | | $I_F$ = 1A | $T_J$ = 25°C | | 0.37 | 0.45 | |
| | | | $T_J$ = 100°C | | 0.3 | 0.42 | |

**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) 87°C/W when mounted on a 1in$^2$ pad of 2 oz copper



b) 166°C/W when mounted on a minimun pad

**2:** Pulse Test: Pulse Width ≤300 ms, Duty Cycle < 2.0%

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

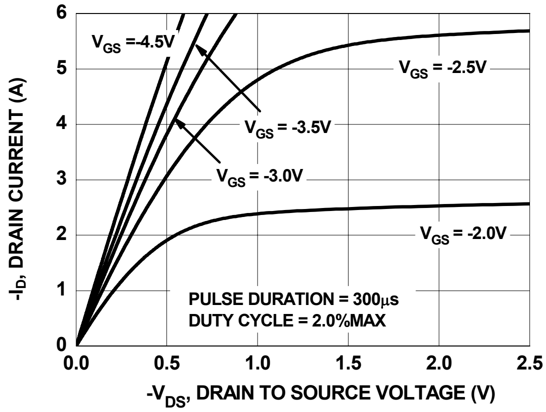



**Figure 1. On Region Characteristics**

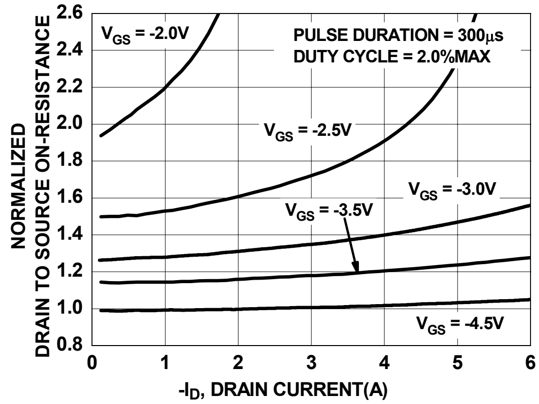



**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**

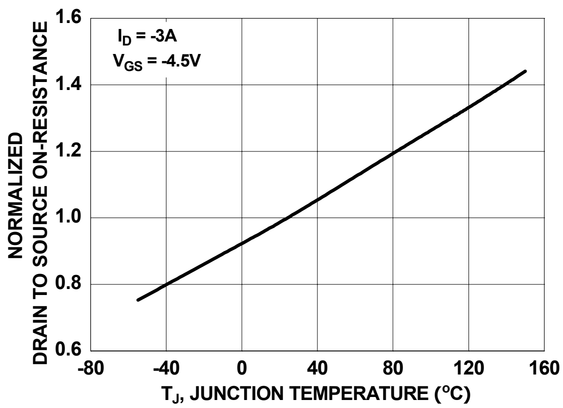



**Figure 3. Normalized On-Resistance vs Junction Temperature**

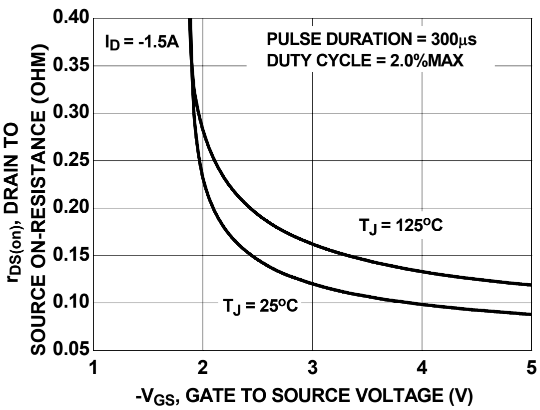



**Figure 4. On-Resistance vs Gate to Source Voltage**

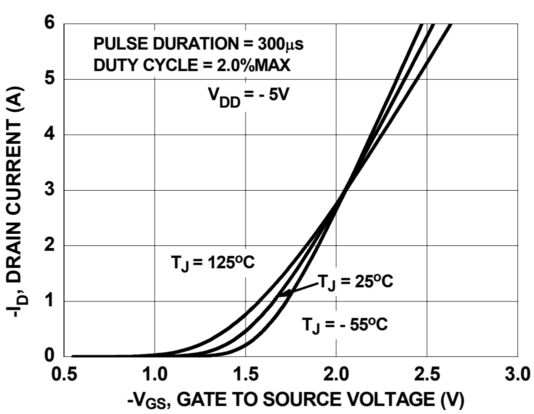



**Figure 5. Transfer Characteristics**

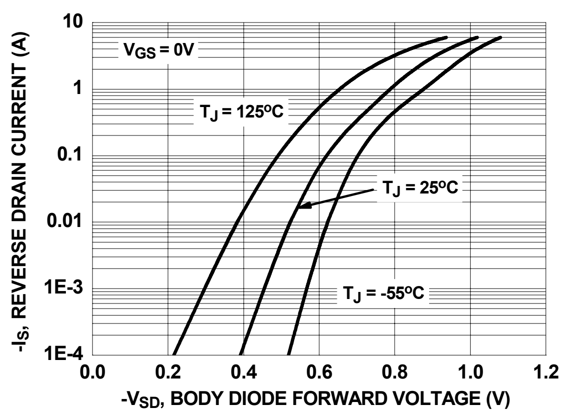



**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

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

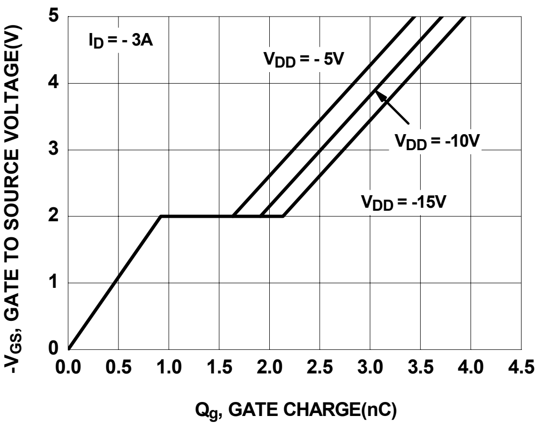



**Figure 7. Gate Charge Characteristics**

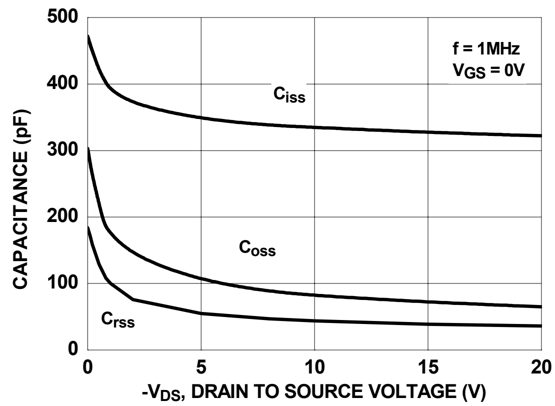



**Figure 8. Capacitance vs Drain to Source Voltage**

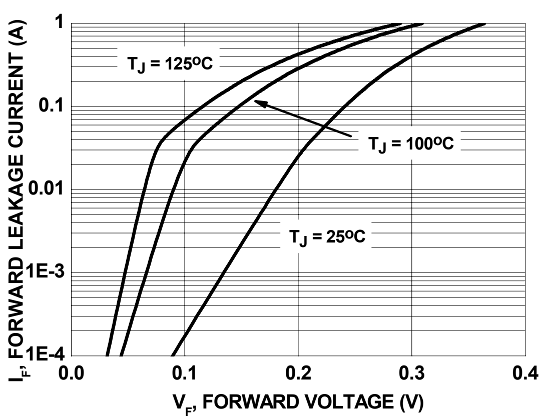



**Figure 9. Schottky Diode Forward Voltage**

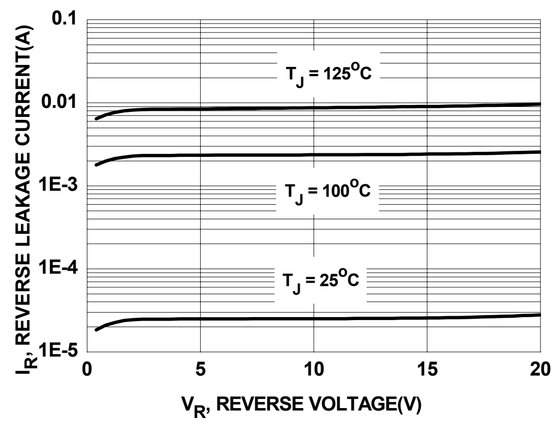



**Figure 10. Schottky Diode Reverse Current**

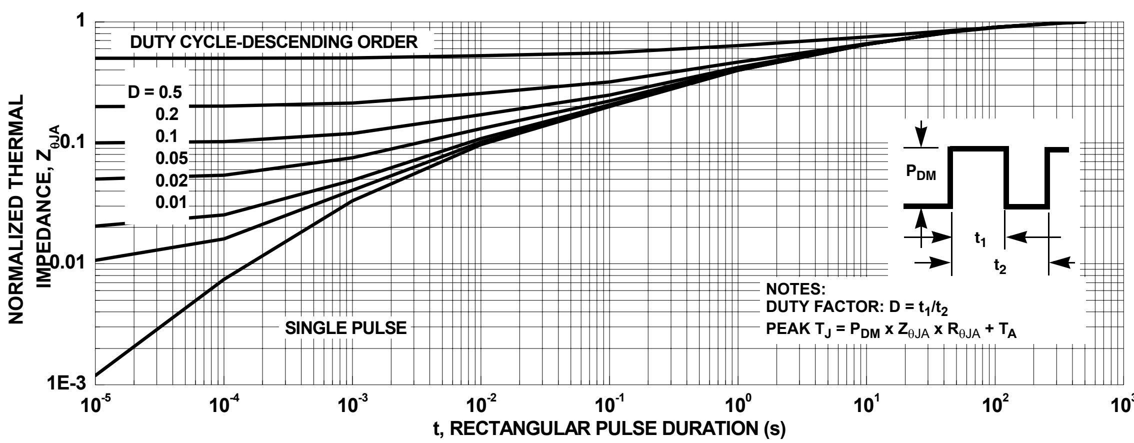



**Figure 11. Transient Thermal Response Curve**

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