FAIRCHILD SEMICONDUCTOR TM

January 2001

# FDC640P

## P-Channel 2.5V PowerTrench® Specified MOSFET

### General Description

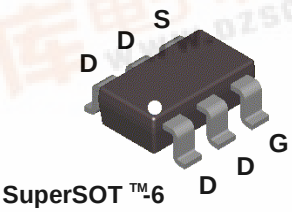
This P-Channel 2.5V specified MOSFET uses a rugged gate version of Fairchild's advanced PowerTrench process. It has been optimized for power management applications with a wide range of gate drive voltage (2.5V – 12V).

### Applications

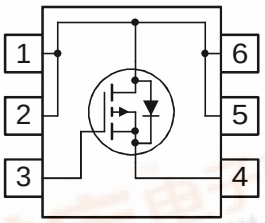
- Battery management
- Load switch
- Battery protection

### Features

- –4.5 A, –20 V $R_{DS(ON)}$ = 0.053 Ω @ $V_{GS}$ = –4.5 V
  $R_{DS(ON)}$ = 0.080 Ω @ $V_{GS}$ = –2.5 V
- Rugged gate rating (±12V)
- Fast switching speed
- High performance trench technology for extremely low $R_{DS(ON)}$




SuperSOT ™-6




## Absolute Maximum Ratings

$T_A$=25°C unless otherwise noted

| Symbol | Parameter | | Ratings | Units |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | –20 | V |
| $V_{GSS}$ | Gate-Source Voltage | | ±12 | V |
| $I_D$ | Drain Current – Continuous | (Note 1a) | –4.5 | A |
| | – Pulsed | | –20 | |
| $P_D$ | Maximum Power Dissipation | (Note 1a) | 1.6 | W |
| | | (Note 1b) | 0.8 | |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | | –55 to +150 | °C |

## Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | (Note 1a) | 78 | °C/W |
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | (Note 1) | 30 | °C/W |

## Package Marking and Ordering Information

| Device Marking | Device | Reel Size | Tape width | Quantity |
|---|---|---|---|---|
| .640 | FDC640P | 7" | 8mm | 3000 units |

## Electrical Characteristics

$T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain–Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = –250 μA | –20 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = –250 μA, Referenced to 25°C | | –14 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = –16 V, $V_{GS}$ = 0 V | | | –1 | μA |
| $I_{GSSF}$ | Gate–Body Leakage, Forward | $V_{GS}$ = 12 V, $V_{DS}$ = 0 V | | | 100 | nA |
| $I_{GSSR}$ | Gate–Body Leakage, Reverse | $V_{GS}$ = –12 V, $V_{DS}$ = 0 V | | | –100 | nA |
| **On Characteristics** (Note 2) | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = –250 μA | –0.6 | –1.0 | –1.5 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D$ = –250 μA, Referenced to 25°C | | 3 | | mV/°C |
| $R_{DS(on)}$ | Static Drain–Source On–Resistance | $V_{GS}$ = –4.5 V, $I_D$ = –4.5 A<br>$V_{GS}$ = –2.5 V, $I_D$ = –3.6 A<br>$V_{GS}$ = –4.5 V, $I_D$ = –4.5A, $T_J$=125°C | | 0.039<br>0.062<br>0.053 | 0.053<br>0.080<br>0.077 | Ω |
| $I_{D(on)}$ | On–State Drain Current | $V_{GS}$ = –4.5 V, $V_{DS}$ = –5 V | –20 | | | A |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = –5 V, $I_D$ = –4.5 A | | 16 | | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = –10 V, $V_{GS}$ = 0 V, f = 1.0 MHz | | 890 | | pF |
| $C_{oss}$ | Output Capacitance | | | 244 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 123 | | pF |
| **Switching Characteristics** (Note 2) | | | | | | |
| $t_{d(on)}$ | Turn–On Delay Time | $V_{DD}$ = –10 V, $I_D$ = –1 A, $V_{GS}$ = –4.5 V, $R_{GEN}$ = 6 Ω | | 12 | 22 | ns |
| $t_r$ | Turn–On Rise Time | | | 9 | 18 | ns |
| $t_{d(off)}$ | Turn–Off Delay Time | | | 24 | 38 | ns |
| $t_f$ | Turn–Off Fall Time | | | 13 | 23 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = –10 V, $I_D$ = –4.5 A, $V_{GS}$ = –4.5 V | | 9 | 13 | nC |
| $Q_{gs}$ | Gate–Source Charge | | | 2 | | nC |
| $Q_{gd}$ | Gate–Drain Charge | | | 3 | | nC |
| **Drain–Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain–Source Diode Forward Current | | | | –1.3 | A |
| $V_{SD}$ | Drain–Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = –1.3 A (Note 2) | | –0.7 | –1.2 | V |

**Notes:**

**1.** $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient 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 1in$^2$ pad of 2oz copper on FR-4 board.

b. 156°C/W when mounted on a minimum pad.

**2.** Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%

## Typical Characteristics

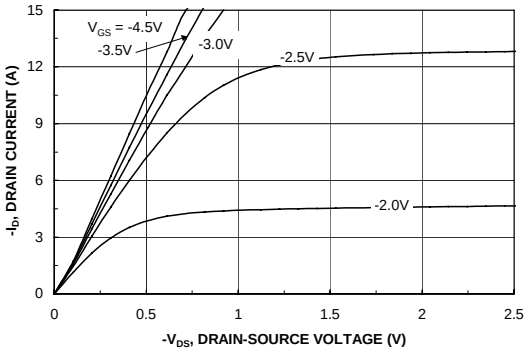



**Figure 1. On-Region Characteristics.**

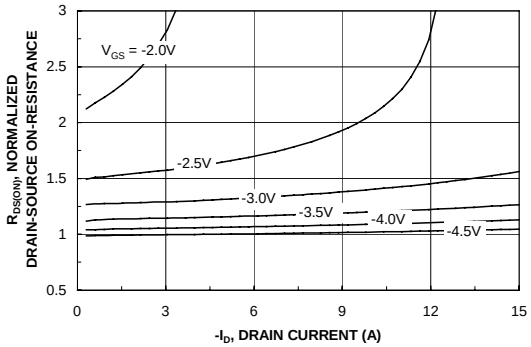



**Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.**

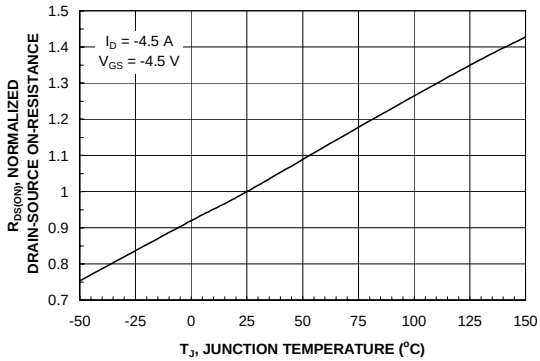



**Figure 3. On-Resistance Variation with Temperature.**

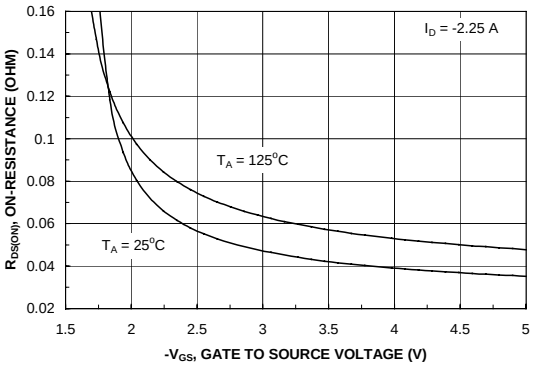



**Figure 4. On-Resistance Variation with Gate-to-Source Voltage.**

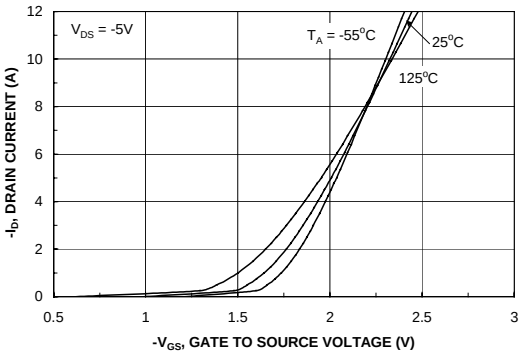



**Figure 5. Transfer Characteristics.**

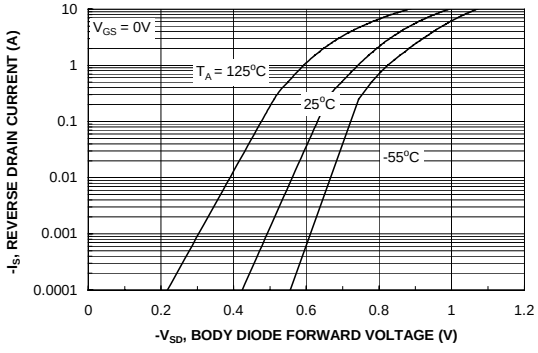



**Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.**

## Typical Characteristics

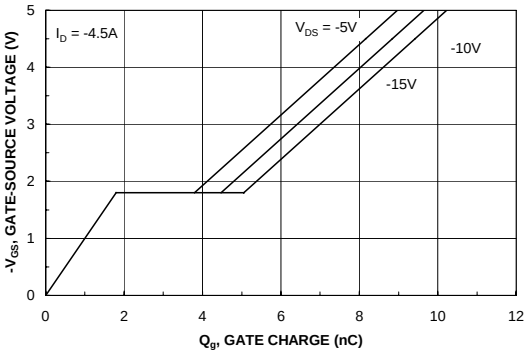



**Figure 7. Gate Charge Characteristics.**

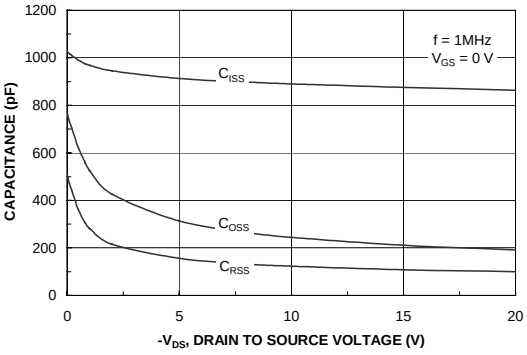



**Figure 8. Capacitance Characteristics.**

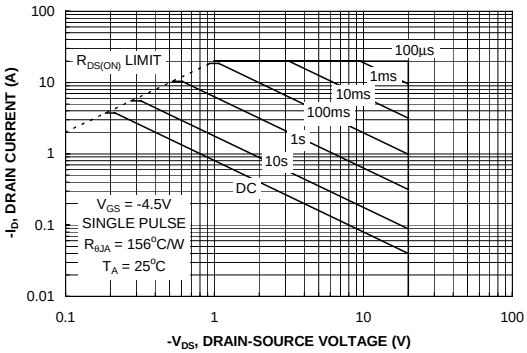



**Figure 9. Maximum Safe Operating Area.**

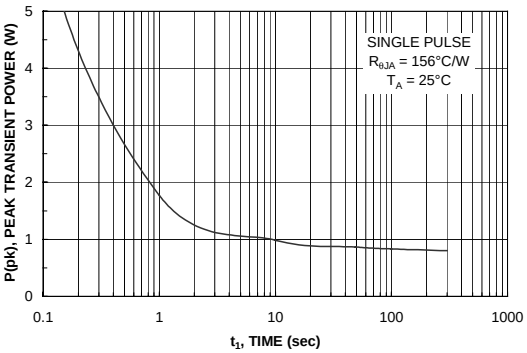



**Figure 10. Single Pulse Maximum Power Dissipation.**

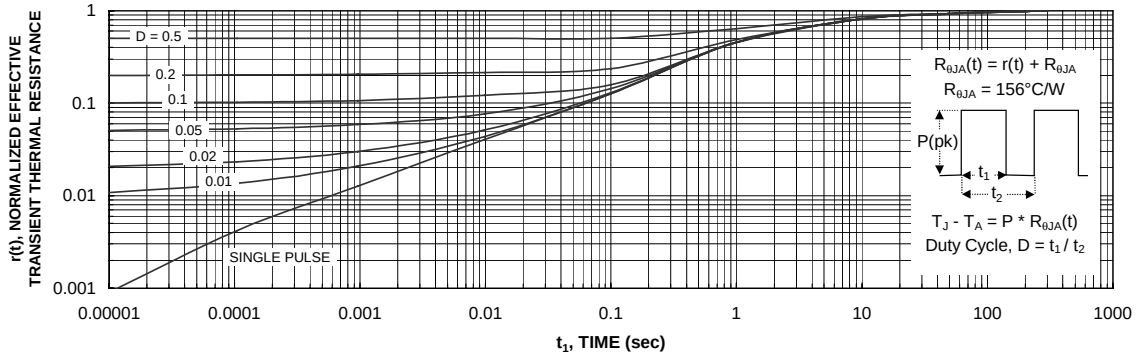



**Figure 11. Transient Thermal Response Curve.**

**Thermal characterization performed using the conditions described in Note 1b**
**Transient thermal response will change depending on the circuit board design.**

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