FAIRCHILD SEMICONDUCTOR TM

April 2001
**PRELIMINARY**

# FDP6021P/FDB6021P

## 20V P-Channel 1.8V Specified PowerTrench® MOSFET

### General Description

This P-Channel power MOSFET uses Fairchild's low voltage PowerTrench process. It has been optimized for power management applications.

### Applications

- Battery management
- Load switch
- Voltage regulator

### Features

- –28 A, –20 V. $R_{DS(ON)}$ = 30 mΩ @ $V_{GS}$ = 4.5 V
  $R_{DS(ON)}$ = 40 mΩ @ $V_{GS}$ = 2.5 V
  $R_{DS(ON)}$ = 65 mΩ @ $V_{GS}$ = 1.8 V
- Critical DC electrical parameters specified at elevated temperature
- High performance trench technology for extremely low $R_{DS(ON)}$
- 175°C maximum junction temperature rating

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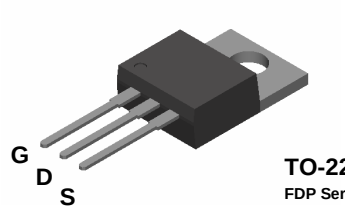
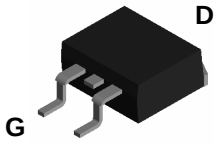
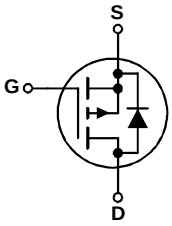



**TO-220**
**FDP Series**




**TO-263AB**
**FDB Series**




## 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 | | ± 8 | V |
| $I_D$ | Drain Current – Continuous | (Note 1) | –28 | A |
| | – Pulsed | (Note 1) | –80 | |
| $P_D$ | Total Power Dissipation @ $T_C$ = 25°C | | 37 | W |
| | Derate above 25°C | | 0.25 | W°C |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | | –65 to +175 | °C |

## Thermal Characteristics

| | | | |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | 4 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 62.5 | °C/W |

## Package Marking and Ordering Information

| Device Marking | Device | Reel Size | Tape width | Quantity |
|---|---|---|---|---|
| FDP6021P | FDP6021P | Tube | n/a | 45 |
| FDB6021P | FDB6021P | 13" | 24mm | 800 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 | | –16 | | 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 | $V_{GS}$ = 8 V, $V_{DS}$ = 0 V | | | 100 | nA |
| $I_{GSSR}$ | Gate–Body Leakage, Reverse | $V_{GS}$ = –8 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 | –0.4 | –0.7 | –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, $I_D$ = –14 A<br>$V_{GS}$ = –2.5 V, $I_D$ = –12 A<br>$V_{GS}$ = –1.8 V, $I_D$ = –10 A<br>$V_{GS}$= –4.5V, $I_D$ = –14 A, $T_J$=125°C | | 24<br>31<br>50<br>30 | 30<br>40<br>65<br>42 | mΩ |
| $I_{D(on)}$ | On–State Drain Current | $V_{GS}$ = –4.5 V, $V_{DS}$ = –5 V | –40 | | | A |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = –5 V, $I_D$ = –14 A | | 33 | | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = –10 V, $V_{GS}$ = 0 V, f = 1.0 MHz | | 1890 | | pF |
| $C_{oss}$ | Output Capacitance | | | 302 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 124 | | 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 | | 13 | 23 | ns |
| $t_r$ | Turn–On Rise Time | | | 10 | 20 | ns |
| $t_{d(off)}$ | Turn–Off Delay Time | | | 80 | 128 | ns |
| $t_f$ | Turn–Off Fall Time | | | 50 | 80 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = –10 V, $I_D$ = –14 A, $V_{GS}$ = –4.5 V | | 20 | 28 | nC |
| $Q_{gs}$ | Gate–Source Charge | | | 4 | | nC |
| $Q_{gd}$ | Gate–Drain Charge | | | 7 | | nC |
| **Drain–Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain–Source Diode Forward Current | | | | –28 | A |
| $V_{SD}$ | Drain–Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = –14 A | | –0.9 | –1.3 | V |

**Notes:**

**1.** Pulse Test: Pulse Width < 300µs, Duty Cycle < 2.0%

**2.** TO-220 package is supplied in tube / rail @ 45 pieces per rail.

**3.** Calculated continuous current based on maximum allowable junction temperature. Actual maximum continuous current limited by package constraints to 75A

## Typical Characteristics

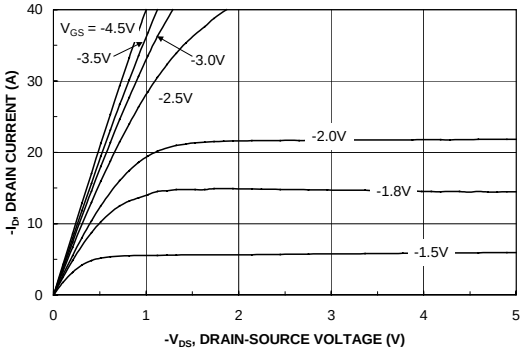



**Figure 1. On-Region Characteristics.**

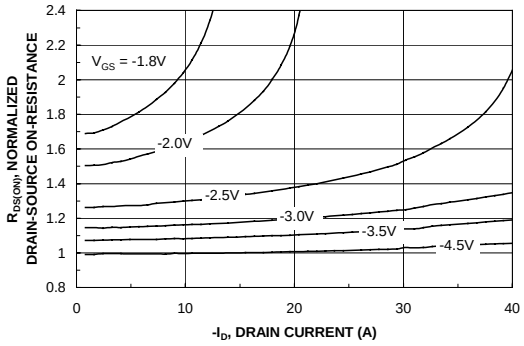



**Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.**

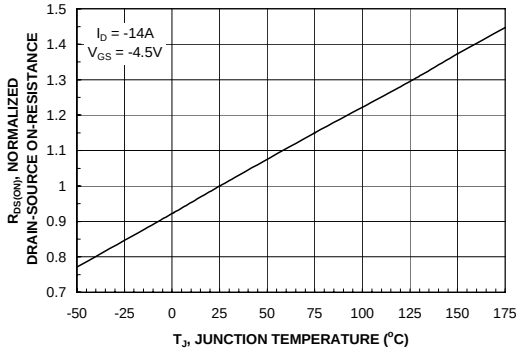



**Figure 3. On-Resistance Variation withTemperature.**

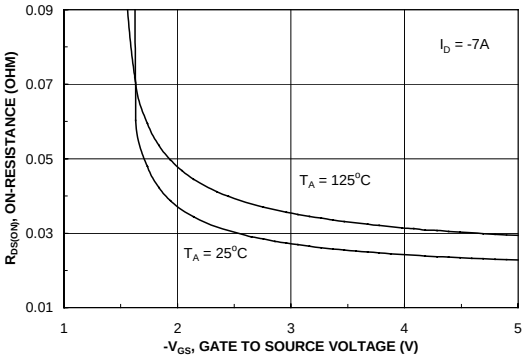



**Figure 4. On-Resistance Variation with Gate-to-Source Voltage.**

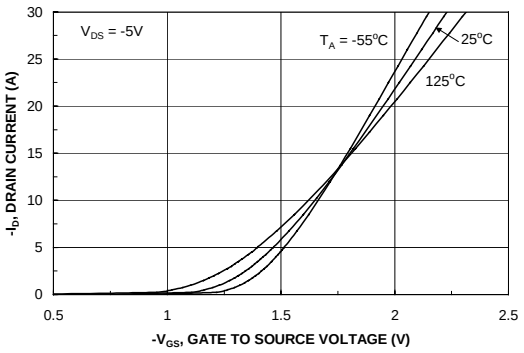



**Figure 5. Transfer Characteristics.**

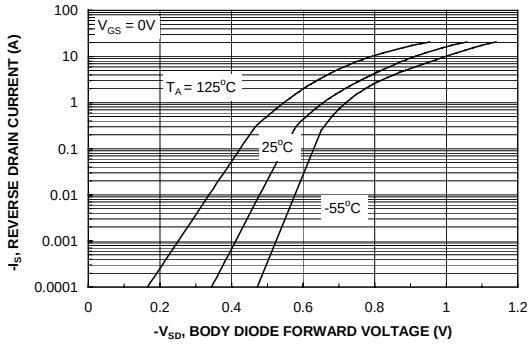



**Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.**

## Typical Characteristics

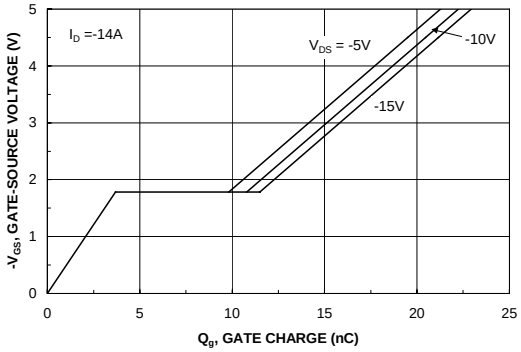



**Figure 7. Gate Charge Characteristics.**

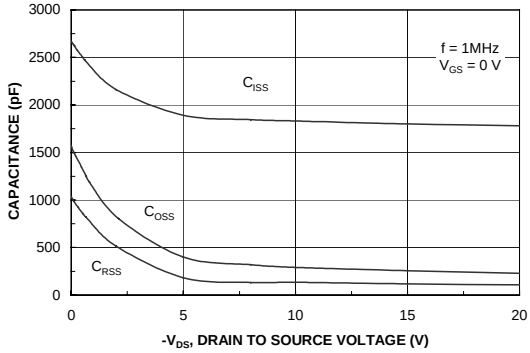



**Figure 8. Capacitance Characteristics.**

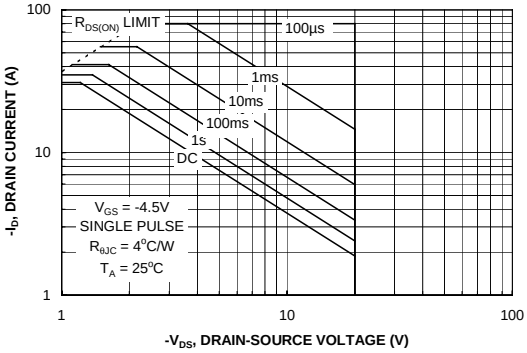



**Figure 9. Maximum Safe Operating Area.**

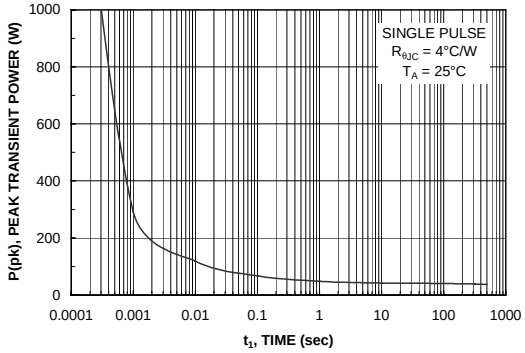



**Figure 10. Single Pulse Maximum Power Dissipation.**

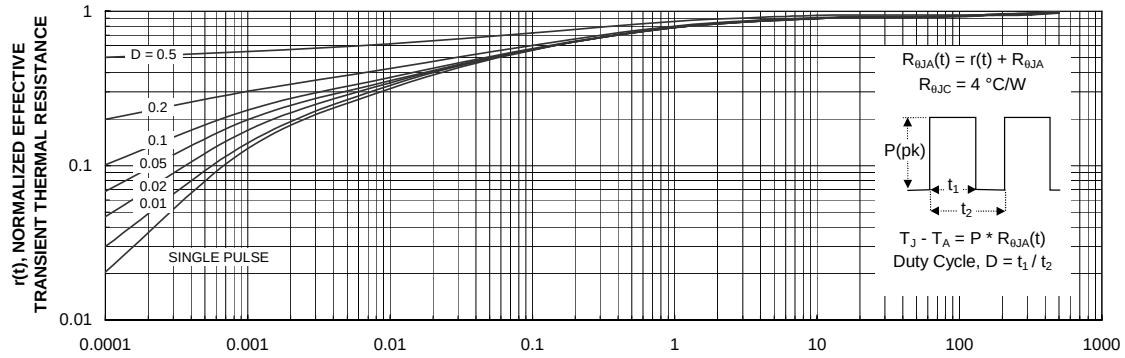



**Figure 11. Transient Thermal Response Curve.**

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